Tracking SDG 7: Energy Progress Report
Arab Region

UNITED NATIONS
الاسكوا
ESCWA

Shared Prosperity Dignified Life

IsDB
البنك الإسلامي للتنمية
Islamic Development Bank

UNITED NATIONS
الاسكوا
ESCWA

Shared Prosperity **Dignified Life**

VISION
ESCWA, an innovative catalyst for a stable, just and flourishing Arab region

MISSION
Committed to the 2030 Agenda, ESCWA's passionate team produces innovative knowledge, fosters regional consensus and delivers transformational policy advice. Together, we work for a sustainable future for all.

E/ESCWA/SDPD/2019/3

Economic and Social Commission for Western Asia

Tracking SDG 7: Energy Progress Report

Arab Region

UNITED NATIONS
Beirut

United Nations publication issued by ESCWA, United Nations House,

Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org.

Photo credits:
Cover: © iStock.com
Page 18: © iStock.com/ipopba
Page 40: © iStock.com/Mlenny
Page 76: © iStock.com/AhmadDiab
Page 92: © iStock.com/ipopba
Page 114: © iStock.com/swisshippo
Page 148: © iStock.com/yewkeo

Acknowledgments

Partnership

Tracking SDG 7: Energy Progress Report 2019, Arab Region is a product of exceptional collaboration between the United Nations Economic and Social Commission for Western Asia (ESCWA) and the Islamic Development Bank Group (IsDB).

Authorship

This report was developed by the Energy Section in the Sustainable Development and Policies Division (SDPD) of ESCWA. The lead authors are Ms. Radia Sedaoui, Chief Energy Section, and Ms. Laura El-Katiri, consultant, with contributions from Mr. Mongi Bida, First Economic Affairs Officer, and Mr. Robert Tromop, consultant.

Data Sources

This report relies on the data provided by the custodian agencies of Sustainable Development Goal 7: World Health Organization (WHO), World Bank, United Nations Statistics Division (UNSD), International Renewable Energy Agency (IRENA), International Energy Agency (IEA) and a combination of data sources for its analysis.

The report draws on two metadatabases of global household surveys – the Global Electrification Database managed by the World Bank (Elisa Portale and Juliette Besnard) and the Global Household Energy Database managed by WHO (Heather Adair-Rohani and Giulia Ruggeri). Energy balance statistics and indicators for renewable energy and energy efficiency were prepared by IEA (Roberta Quadrelli, Sharon Burghgraeve and Francesco Mattion) and UNSD (Leonardo Souza and Agnieszka Koscielniak) complemented by data on electricity generation from solar and wind energy and off-grid access, provided by IRENA (Adrian Whiteman and Samah Elsayed). Data on gross domestic product and value added were drawn from the World Development Indicators of the World Bank.

Data on individual countries was also provided during a consultative seminar on "Monitoring the Implementation of Energy-related SDG Indicators in the Arab Region" held in April 2019 where ESCWA member countries provided valuable input on their respective countries.

Members of the ESCWA Committee on Energy and Experts:

Mr. Nader Mohamed Lotfi Mohrm, Senior Engineer at Research, Planning and Authorities Follow-up Department, Ministry of Electricity and Renewable Energy, Egypt; Mr. Mustafa Mohammad Mustafa Khatib, Director of Electricity Department, Ministry of Energy and Mineral Resources, Jordan; Mr. Zeyad Jamil Abdel Rahman Alsaaydeh, Director of Rural Electrification Department, Ministry of Energy and Mineral Resources, Jordan; Ms. Alaa Abdulla, Executive Director, Jordan Green Building Council, Jordan; Mr. Omar Abdelaziz Alwasmi, Controller of Organization and International relation, Ministry of Oil, Kuwait; Ms. Aurore Feghaly, General Director of Oil, Ministry of Energy and Water, Lebanon; Mr. Hamid H. M. Sherwali, Chairperson of Board of Renewable Energies, Renewable Energy Authority, Libya; Mr. Eltayeb Dafaalla Ahmed Ismail, Manager of Electricity Planning Department, , Ministry of Water Resources, Irrigation and Electricity, the Sudan; Ms. Hazir Farouk Abdelraheem Elhaj, Assistant Professor, University of Science and Technology, the Sudan; Ms. Hiam Imam, Director for Electricity Sector Regulatory, and Private Investment, Ministry of Electricity, Arab

Republic of Syria; Mr. Mohamed Bassam Al-Darwish, Director for Planning and Statistics, Ministry of Electricity, Arab Republic of Syria; Mr. Mohamed Yarguett, Minister's advisor in charge of Electricity, Ministry of Petroleum, Energy and Mines, Mauritania; Ms. Vatimetou Sid Elemine, Head of Electrification Division, Ministry of Petroleum, Energy and Mines, Mauritania; Mr. Tigran Parvanyan, Energy Specialist, Energy Sector Management Assistance Program (ESMAP), World Bank; and Robert Tromop, Energy Efficiency Consultant.

Focal Points of Statistics:

Ms. Wafa Aboul Hosn, Chief Economic Statistics, Statistics Division, ESCWA, Ms. Abeer Mohamed Eid, Statistician and Head of Electricity and Energy Department, Central Agency for Public Mobilization and Statistics (CAPMAS), Egypt; Mr. Zaid Khaleefah Mohamed, Statistician Ministry of Planning, Central Statistics Organization, Iraq; Mr. Nimer Hashem Gharbia, National Coordinator of Energy Sector, Head of Industry and Energy Division, Department of Statistics, Jordan; Mr. Ali E.A. Grera, Executive Director, Bureau of Statistics and Census, Libya; Mr. Ibrahim Said Muhanna Al Hinai, Head of Government Economic Statistics Department National Center For Statistics and Information, Oman; Mr. Mohammed Shaheen, Head of Natural Resources and Water Statistics Division, Palestinian Central Bureau of Statistics, State of Palestine; Ms. Afkar Eltaib Awadelkrim Abdalla, Manager, Central Statistics Organization, the Sudan; Mr. Ihsan Saber Amer, Head Manager, Central Bureau of Statistics, Syrian Arab Republic; Ms. Olfa Bouazizi, Head of Unit, National Institute of Statistics, Tunisia.

Review and Consultation

The public consultation and peer review process were coordinated by ESCWA including the abovementioned regional seminar on "Monitoring the Implementation of Energy-related SDG Indicators in the Arab Region" organized by ESCWA in Beirut in April 2019. Substantive comments and inputs were also provided by regional and international organizations as follows:

International and Regional Organizations:

Ms. Jamila Youssef Matar, Head of Energy Department, League of Arab States, Cairo; Mr. Mohammed Alsayed, Manager, Economic Infrastructure Division, Economic and Social Infrastructure Department Islamic Development Bank Group (IsDB); Mr. Hussain Mogaibel, Global Lead Energy Specialist, Economic Infrastructure Division, Economic and Social Infrastructure Department, IsDB; Ms. Roberta Quadrelli, Head, Balances, Prices, Emissions and Energy Efficiency, IEA Energy Data Centre, IEA, Vienna; Ms. Laura Cozzi, Chief Energy Modeller, IEA; Mr. Joe Ritchie, Energy Policy Analyst, Energy Efficiency, IEA; Mr. Francesco Mattion, Energy Data Officer, IEA Energy Data Centre, IEA; Ms. Rabia Ferroukhi, Director Knowledge, Policy and Finance Centre, IRENA; Mr. Adrian Whiteman, Head of Statistics, IRENA; Ms. Samah Elsayed, Programme Officer, IRENA; Ms. Elisa Portale, Senior Energy Specialist, Energy Knowledge Hub Coordinator Energy Sector Management Assistance Program (ESMAP), World Bank; Ms. Juliette Besnard, Energy Specialist, ESMAP, World Bank; Mr. Raihan Elahi Lead Energy Specialist, Energy and Extractives, World Bank; Mr. Tigran Parvanyan, Energy Specialist, ESMAP, World Bank; Mr. Nicholas Howarth, Research Fellow, Energy Transitions and Environment, King Abdullah Petroleum Studies and Research Center (KAPSARC), Saudi Arabia; Mr. Hosni Ghedira, Director, Research Centre for Renewable Energy Mapping and Assessment, Masdar Institute, United Arab Emirates; Mr. Osamah Alsayegh, Executive Director, Energy and Building Research Center, Kuwait Institute for Scientific Research, United Arab Emirates; Ms. Chris Heitzig, Student Graduate University of Oxford, United States or America, Mr. Fidele Byiringiro, Economic Affairs Officer, ESCWA; Mr. Rabi' Bashour, Economic Affairs Officer, Emerging and Conflicts Related Issues (ECRI) Division, ESCWA; Ms. Maya Antoine Mansour, Research Assistant, Energy Section, ESCWA; and Mr. Ziad Khayat, First Economic Affairs Officer, Water Section, SDPD, ESCWA.

Executive Summary

1. **Progress in sustainable energy lies at the heart of socioeconomic growth and sustainable development across the Arab region.** Ensuring access to affordable, reliable, sustainable and modern energy for all (Sustainable Development Goal 7 (SDG 7)) is a key condition for reducing inequalities, poverty eradication, advances in health and education, sustainable economic growth, and the principle of "leaving no one behind", in addition to climate action. Mainstreaming sustainable energy also presents significant opportunities for achieving a greater gender balance in the Arab region, including through improved energy access for women, access to medical services and education, and job opportunities.

2. **Long-term progress in the Arab region as a whole has been particularly positive for Sustainable Development Goal sub-target 7.1 ("universal access to affordable, reliable and modern energy services"), with the exception of Arab least developed countries (LDCs).** The Arab region's population without access to electricity fell from some 40 million in 2010 to some 30 million in 2017. Thanks to dedicated policy efforts in a number of Arab countries with remaining access deficits during the 2000s, electricity access was virtually universal by 2017 in all but three Arab countries. The Arab region's remaining electricity access deficit is concentrated in the LDCs Mauritania, the Sudan and Yemen, where, in turn, it is a significant obstacle to wider socioeconomic development.

3. **Progress in other SDG 7 targets is not on track.** The share of renewable energy in total final energy consumption (SDG 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix) has been in slow decline in the Arab region, a historical long-term trend that reflects the increased displacement of traditional solid biofuel in favour of modern liquid fuels and electricity, with a limited role played by other, modern renewable energy. Overall, the share of renewable energy has been plateauing at around 10.2 percent of the Arab region's total final energy consumption (TFEC) since 2010, with Arab LDCs accounting for a large proportion of renewable energy use through traditional biomass, which declined by another 11 percent between 2014 and 2016. Individual country progress in accelerated deployment of solar energy in particular over the tracking period has not been enough to counter this trend, with renewable energy contributing negligibly to total primary energy supply (TPES) in most non-LDCs. The Arab region's energy intensity (EI) (SDG 7.3: By 2030, double the global rate of improvement in energy efficiency (EE)) has continued to decline at a rate of 2.2 percent between 2014 and 2016 against a long-term trend of higher energy intensity during the 2000s than in 1990, but is not enough to bring the region in line with its need to decouple economic growth and energy consumption.

4. **Progress in the Arab LDCs across SDG 7 targets lags far behind the rest of the region: reinforced action is urgently needed to achieve SDG 7 by 2030.** The Sudan alone accounts for some 17.7 million people without access to electricity, and some 22.7 million people without clean fuels and technologies (CFTs) for around two-thirds of the Arab region's total access deficit for electricity and CFTs, making it one of the world's 20 largest deficit countries in 2017. Vast gaps in access between urban and rural areas across Arab LDCs result in highly precarious living conditions for millions of people. The share of renewable energy in the Arab LDCs' energy mix tends to be higher than elsewhere in the region, owing to greater reliance on solid

biofuel—much of which is traditional biomass—implying this share is expected to decline further, rather than to increase, together with improving living standards. Energy intensity is comparably low, but reflects both lacking industrialization and access to energy, with future improvements in energy access expected to raise this rate in the absence of the widespread adoption of energy efficient technology.

5. **Conflict and instability have added further long-term challenges to progress in SDG 7 in a number of Arab countries in recent years.** The destruction of infrastructure, the erosion of state institutions and political uncertainty have not only contributed to the erosion of past progress—for instance in the case of secure access to electricity and CFTs—but is also a major liability in these countries' attitude to investing in energy-related policies with a long-term perspective. Neighbouring countries, too, have been affected, through the rapid influx of refugee populations who add further pressure on energy systems with many pre-existing bottlenecks. Ensuring these countries are able to rebuild strong, resilient energy systems will require active assistance, ranging from technical and planning ability to effective institution building and access to finance.

6. **Progress in SDG 7 and SDG 13 (Climate action) go hand in hand.** The Arab region is highly vulnerable to future effects of climate change. These threaten the livelihood of millions by impacting the availability of arable land, drinking water, through increased heat, and the more frequent occurrence of natural disasters. The World Health Organization (WHO) outdoor air-quality data show that the Arab region is one of the most polluted regions in terms of outdoor air quality worldwide. The burning of fossil fuels to supply the world's growing populations and economies with energy has been a key cause of the release of carbon dioxide and other greenhouse gases (GHGs) into the atmosphere that is linked to climate change. Decoupling economic growth and prosperity from energy use by increasing the share of sustainable, clean energy sources and by increasing the efficiency and productivity of energy use as envisioned under SDG 7 is hence a key step to climate action under SDG 13. Progress in SDG 7 is also essential in this regard.

7. **Arab countries need to step up their efforts to achieve both the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change.** The Arab region is neither on track to meet its SDG 7 target nor its targets under SDG 12. Extending the pace of regional progress in sustainable energy requires much more policy action than has been the case in the past. Local markets need to be equipped with effective policy frameworks that move beyond lip service. This includes setting the right incentives through the availability of finance, investments in sustainable and clean energy, education infrastructure and services, as well as the removal of many existing market barriers. At the state level, inclusive, transparent and competent institutions are critical to achieving truly sustainable energy policies that move beyond window-dressing. Updated Nationally Determined Contributions (NDCs), due in 2020, should fully reflect concrete goals for renewable energy and energy efficiency. In turn, Arab countries can expect significant opportunities from the pursuit of energy and climate action, including the promotion of new, knowledge-based industries and the creation of jobs.

8. **Strengthening regional cooperation among Arab countries could be a fruitful avenue to support the common goal of more sustainable energy systems**. A successful energy transition that fosters more inclusive and more sustainable societies in the Arab region will hold benefits for all and will contribute to greater regional peace and security. The reverse is also true: failure to take action and build energy- and climate-resilient economies will affect Arab countries' positioning within the emerging geopolitical landscape that will undoubtedly change over the coming decades as global energy transition progresses. Policy choices made today will affect this position, and whether or not Arab countries will stand to lose or benefit from the global energy transition.

9. Arab LDCs will require special support to accelerate progress in SDG 7 and SDG 13. Closing the energy access gap in Arab LDCs will be more challenging than elsewhere, owing to the considerable size of the challenge, coupled with institutional and financial constraints. Despite progress in recent years in the area of access to electricity and CFTs, strong policy commitment must be accompanied by effective long-term energy planning, the provision of adequate financing and regulatory and fiscal incentives. Lack of sustainable energy access is a fundamental development challenge in LDCs, holding back progress across other development goals such as poverty eradiation and access to education and health, where urgent progress is required. The more effective use of development aid to support scalable, replicable projects with demonstrable benefits for local communities is one concrete way in which external parties such as development banks and third countries can support Arab LDCs in this task.

Contents

P. 3 **Acknowledgments**
P. 5 **Executive summary**
P. 13 **Acronyms and abbreviations**
P. 17 **Introduction**

P. 19 **1. Energy access**
P. 21 Access to electricity
P. 21 Main messages
P. 22 Are we on track?
P. 25 Throughout the region, access growth mostly surpasses population growth
P. 26 The overall access deficit is declining but remains acute in a small number of countries
P. 27 Most of the access deficit remains concentrated in rural areas
P. 29 Conflict, occupation and instability have led to a regression in access
P. 31 Electricity access does not mean reliable electricity services.
P. 32 Affordability is linked to service quality and the rate of access
P. 35 Access to clean fuels and technologies for cooking
P. 35 Main messages
P. 35 Are we on track?
P. 37 Population growth has slowed access growth in some countries over the tracking period
P. 38 Arab LDCs account for virtually the entire region's access deficit
P. 39 The urban–rural divide remains strong in key deficit countries
P. 40 Political conflict has contributed to slower progress
P. 40 Policy implications

P. 43 **2. Energy Efficiency**
P. 43 Main messages
P. 44 Are we on track?
P. 50 What has caused regional energy intensity to decline?
P. 50 GCC countries shift structure and advance energy efficiency
P. 52 Some countries are reducing their historical energy growth trends
P. 52 Improving value from economic activity
P. 53 Investment drivers of energy efficiency
P. 56 Agriculture and services see the largest fall in energy intensity since 2010
P. 57 Electricity and water
P. 58 Transport
P. 64 Industries
P. 67 Agriculture
P. 68 Residential and commercial buildings
P. 76 Policy implications

P. 79 3. Renewable energy
P. 79 Main messages
P. 80 Are we on track?
P. 81 Solid biofuel continues to dominate regional renewable energy consumption
P. 82 The contribution of renewable energy to the region’s energy mix remains marginal
P. 84 The dominant use of renewable energy remains in heat raising …
P. 85 … though the fastest growth occurs in electricity generation
P. 87 Distributed generation is growing rapidly …
P. 90 …with high relevance for conflict-affected countries as well
P. 92 Renewables have not yet entered the region’s transport sector
P. 92 Policy implications

P. 95 4. Sustainable energy and climate change
P. 95 Main messages
P. 96 The Arab region is highly vulnerable to climate change
P. 100 SDG 7 and SDG 13 are closely interlinked
P. 104 Air pollution and the carbon footprint
P. 106 Climate action in the power and water sector
P. 111 Aligning SDGs and NDCs
P. 112 Policy implications

P. 115 5. Country profiles

P. 151 Conclusion
P. 155 Annex
P. 159 About the data used in this report
P. 166 Appendix
P. 171 Bibliography
P. 179 Endnotes

List of figures

P. 23 Figure 1. Progress in population with electricity access in the Arab region from 2010 to 2017
P. 23 Figure 2. Electrification rates in the Arab region, 2000-2017
P. 24 Figure 3. Average annual increase in access rate to electricity
P. 25 Figure 4. Share of population with electricity access in urban and rural areas from 2010 to 2017
P. 26 Figure 5. Annual incremental access and population growth, 2014-2017, by Arab subregion
P. 26 Figure 6. Evolution of electrification access-deficit, 2005-2017
P. 27 Figure 7. The Arab region’s electrification access-deficit in population numbers, 2010 and 2017
P. 27 Figure 8. Access to electricity in the Arab LDCs, 2017
P. 28 Figure 9. Annual incremental increases in population and population with access to electricity, 2014-2017
P. 28 Figure 10. Share of population with electricity access in urban and rural areas from 2010 to 2017
P. 33 Figure 11. Affordability of electricity for households in the Arab region, 2016

P. 36 Figure 12. Progress in clean cooking access from 2000 to 2017
P. 37 Figure 13. Average annual increase in access rate to clean cooking, Arab region and Arab LDCs
P. 38 Figure 14. Annual incremental access and population growth, in the Arab LDCs, 2015-2017
P. 39 Figure 15. The Arab region's clean cooking access-deficit in population numbers, 2010 and2017
P. 39 Figure 16. Share of population with access to CFTs in Arab LDCs, 2017
P. 45 Figure 17. World regional energy intensity trends 1990-2016
P. 46 Figure 18. Arab sub-region energy intensity trends from 1990
P. 47 Figure 19. Energy intensity trends in Maghreb
P. 48 Figure 20. Energy Intensity in Mashreq countries
P. 49 Figure 21. Energy intensity in Gulf Cooperation Council countries
P. 50 Figure 22. Energy intensity trends in Arab LDC countries
P. 51 Figure 23. Trends in TPES, GDP and energy intensity - Arab countries
P. 51 Figure 24. Biennial changes in country energy intensity
P. 52 Figure 25. Arab region countries: Total Primary Energy Supply
P. 53 Figure 26. Economic activity trends in the Arab region 2000-2016
P. 56 Figure 27. Growth rate of energy intensity by sector in the Arab region, 2010-2016
P. 56 Figure 28. Change in sectoral energy intensity in the Arab region, 2012-2016
P. 57 Figure 29. Total generated output and CCGT output in Arab power sectors in 2016
P. 58 Figure 30. Country total transmission & distribution losses in the Arab region, 2016
P. 60 Figure 31. Vehicle ownership rates in the Arab region
P. 61 Figure 32. Urbanization in Arab countries, 2016
P. 63 Figure 33. Urban motorized travel modes in selected Arab cities
P. 64 Figure 34. Industry value added in the Arab region, 2012-2016
P. 65 Figure 35. Oil-exporting Arab countries' industry value added structure, 2000-2016
P. 65 Figure 36. Oil-importing countries industry value added structure, 2010-2016
P. 68 Figure 37. Regional building electricity use
P. 80 Figure 38. Renewable energy share in total final energy consumption, 2000-2016
P. 81 Figure 39. Total Arab renewable energy consumption by country, 2016
P. 81 Figure 40. Renewable energy consumption by type of fuel in the Arab region, 2016
P. 82 Figure 41. Share of individual renewable energy sources in total final energy consumption, by Arab region country, 2016
P. 83 Figure 42. Renewable energy share in total final energy consumption by technology, 2016
P. 84 Figure 43. Renewable energy consumption by fuel and country
P. 85 Figure 44. Final consumption of renewable energy by end-use sector, 2016
P. 86 Figure 45. Electricity generation from wind energy in the Arab region, 2000-2016
P. 86 Figure 46. Electricity generation from solar energy in the Arab region, 2000-2016
P. 87 Figure 47. Arab countries with highest off-grid access rate
P. 88 Figure 48. Top 20 countries with the highest share of solar lighting systems in 2017
P. 96 Figure 49. Water scarcity and energy intensity
P. 101 Figure 50. SDG 7, SDG 13 and their relation to other sustainable development goals
P. 104 Figure 51. Total greenhouse gas emissions by world region, 2012
P. 104 Figure 52. Total greenhouse gas emissions, 2012
P. 105 Figure 53. Total greenhouse gas emissions by country, 2012
P. 112 Figure 54. Advancing the integration and alignment of policies for SDG outcomes

List of Tables

P. 55 Table 1. Changes to subsidies during the period 2014-2017
P. 66 Table 2. Industrial policies in Arab countries in 2016
P. 69 Table 3. Building code and MEPS coverage of final energy for Arab countries by mid-2019
P. 73 Table 4. Potentials to reduce energy use and related emissions in the Arab building sector
P. 74 Table 5. Country energy efficiency policy progress and challenges
P. 155 Table 6. SDG 7 Energy efficiency, renewable energy in Transport
P. 156 Table 7. SDG 7 Energy efficiency, renewable energy in Industry
P. 156 Table 8. SDG 7 Energy efficiency, renewable energy in buildings
P. 158 Table 9. SDG 7 Cross-sectoral policies and measures
P. 159 Table 10. Subregional groups and countries in the Arab region, 2017

List of Boxes

P. 24 Box 1. Gaps in energy-access data
P. 30 Box 2. The effects of conflict on electricity access and living conditions in Yemen
P. 34 Box 3. Gender and access to modern energy
P. 37 Box 4. Cooking fuels used in the Arab region
P. 54 Box 5. Super ESCOs in the Arab region
P. 55 Box 6. Price elasticity for fuel economy and fuel price changes
P. 59 Box 7. Energy efficiency focus on high-use oldest vehicles support achieving SDG gains in Cairo
P. 62 Box 8. Sustainable public transport projects in the Arab Region in 2019
P. 63 Box 9. Sustainable transport policies in Saudi Arabia
P. 72 Box 10. Capacity building supports building energy efficiency policies in Saudi Arabia
P. 73 Box 11. Emerging energy efficiency in the Sudan
P. 89 Box 12. Increasing use of distributed solar systems in Jordan
P. 91 Box 13. Off-grid electricity access using solar technology in Mauritania
P. 97 Box 14. Challenges to effective water governance in the Arab region
P. 99 Box 15. Modelling vulnerability to climate impacts in the Arab region
P. 103 Box 16. Energy efficiency and carbon-productivity in Saudi industries
P. 106 Box 17. A stock model of GCC power-water plants
P. 108 Box 18. Regional initiatives to address water security and climate change
P. 110 Box 19. Sustainable energy transition; zero emissions by 2050 in the Arab region
P. 111 Box 20. Progressing beyond energy efficiency in Tunisia to pursue SDGs and carbon objectives
P. 114 Box 21. The Arab Centre for Climate Change Policies at ESCWA

Acronyms and Abbreviations

ADFD	Abu Dhabi Fund for Development
AED	United Arab Emirates dirham
CAFÉ	corporate average fuel economy
CAGR	compound average growth rate
CCGT	combined cycle gas turbines
CEDRO	Country Energy Efficiency and Renewable Demonstration for the Recovery of Lebanon
CFL	compact fluorescent lamp
CFTs	clean fuels and technologies for cooking
CHP	combined heat and power
CNG	compressed natural gas
CO_2	carbon dioxide
CSP	concentrated solar power
CST	concentrated solar thermal
DNA	Dynamic Damage and Needs Assessment
DREI	derisking renewable energy investment
DSM	demand-side management
DZD	Algerian dinar
ECOWAS	Economic Community of West African States
ECA	Economic Commission for Africa
EE	energy efficiency
EGP	Egyptian pound
EI	energy intensity
EJ	exajoules
EOR	enhanced oil recovery
ESCO	energy service company
ESCWA	United Nations Economic and Social Commission of Western Asia
ESMAP	Economic Sector Management Assistance Programme
EU	European Union
G20	Group of Twenty
GBV	gender-based violence
GCC	Gulf Cooperation Council
GDP	gross domestic product
GFCF	gross fixed capital formation
GHG	greenhouse gas
GPWG-DB	global poverty working group database
GTF	Global Tracking Framework
GW	gigawatt
GWh	gigawatt-hour
HDV	heavy duty vehicles
IEA	International Energy Agency

IECI	intensive energy consuming industries
IMF	International Monetary Fund
INDC	intended nationally determined contributions
IRENA	International Renewable Energy Agency
IRES	International Recommendations for Energy Statistics
ISIC	International Standard Industrial Classification
IWPP	integrated water and power plants
JRP	Jordan Response Plan
KAPSARC	King Abdullah Petroleum Studies and Research Centre
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
kt	kiloton
kW	kilowatt
KWh	kilowatt-hour
l	litre(s)
LDC	least developed countries
LDVs	light-duty vehicles
LED	light-emitting diodes
LPG	liquefied petroleum gas
LRT	light rail transit
m	metre
M&V	measurement & verification
m^2	square metre
MAD	Moroccan dirham
MEMR	Ministry of Energy and Mineral Resources (Jordan)
MENA	Middle East and North Africa
MEPS	minimum energy performance standards
MJ	megajoule
MJ/USD 2011 PPP	megajoules per 2011 US dollars at purchasing power parity
Mn	million
MoU	memorandum of understanding
MRV	monitoring, reporting and verification
mt	million tons
$MtCO_2$	megatons of carbon dioxide
MW	megawatt
NDCs	nationally determined contributions
NEEAP	National Energy Efficiency Action Plan
NEEREA	National Energy Efficiency and Renewable Energy Action (Lebanon)
NES	national energy strategy
pkm	passenger-kilometre
PEI	primary energy intensity
PERG	Programme d'Electrification Rurale Global
PJ	petajoule
PPP	purchasing power parity
PV	photovoltaic
RE	renewable energy
REEL	renewable energy and energy efficiency law

RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
RISE	regulatory indicators for sustainable energy
ROGEP	regional off-grid electrification project
RSB	Regulatory & Supervisory Bureau
SAR	Saudi riyal
SDG	sustainable development goals
SDG 7	Sustainable Development Goal 7
SEEC	Saudi Energy Efficiency Centre
SEforAll	Sustainable Energy for All
SKTM	Shariket Kahraba wa Taket Moutadjadida
SME	small and medium-sized enterprises
SOMELEC	Société Mauritanniene d'électricité (Mauritanian Electricity Corporation)
SWHs	solar water heaters
tkm	tons-kilometre
T&D	transmission and distribution
t/yr	tons per year
TFC	total final consumption
TFEC	total final energy consumption
TND	Tunisian dinar
TPES	total primary energy supply
TWh	terawatt-hour
UN	United Nations
UNDP	United Nations Development Programme
ESCWA	United Nations Economic and Social Commission for Western Asia
UNFCCC	United Nations Framework Convention on Climate Change
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
UNSD	United Nations Statistics Division
USA	United States of America
USD	United States dollar
VFEL	Vehicle Fuel Economy Labelling
VFES	Vehicle Fuel Economy Standards
WB	World Bank
WHO	World Health Organization
^{0}C	degree Celsius
mg/m^3	micrograms per cubic metre

Introduction

The 2030 Agenda for Sustainable Development was adopted by all United Nations Member States in September 2015. Core to all development action are the 2030 Agenda's 17 Sustainable Development Goals (SDGs) that set out a common vision for how to build a peaceful and prosperous future for all, through growth that supports this and coming generations. In December 2015, world leaders signed the Paris Agreement, which sets out additional goals for global climate action.

This report is part of a long-standing effort to track global progress in sustainable energy. The Sustainable Energy for All (SEforAll) Global Tracking Framework (GTF) has had three global editions since its launch in 2013, with biannual updates, led by the World Bank (WB)/Economic Sector Management Assistance Programme (ESMAP) and the International Energy Agency (IEA), with inputs from more than 20 organizations worldwide. The GTF was put in place as the platform that tracks progress towards sustainable energy globally through the collection and analysis of quantifiable, internationally comparable energy-related indicators to provide the international community with a more detailed insight report into progress on the three pillars of sustainable energy: energy access, energy efficiency, and renewable energy.

Since 2019, the GTF has become the Tracking SDG 7: Energy Progress Report, which will continue to be led by SDG 7 custodian agencies (WB, WHO, IEA, the International Renewable Energy Agency (IRENA) and the United Nations Statistics Division (UNSD), all appointed by the United Nations as global custodian agencies responsible for collecting and reporting data related to the energy targets of SDG 7.

Tracking SDG 7 progress in the Arab region

The Executive Secretaries of the United Nations Regional Commissions have called for Member States to accelerate the transition to a new, sustainable and fair energy system, tailored to both national and global needs in the 2030 Development Agenda context. However, to address the gap between current actions taken by governments and the commitments they have made, it is necessary to understand the gaps in their various dimensions.

The year 2017 was the first year of individual reports by the UN regional commissions, including the Economic and Social Commission for Western Asia (ESCWA) on sustainable energy in the Arab region. The first regional edition of the GTF Arab Regional report provided an overview of the progress made by the Arab region in recent years in areas of sustainable energy management and universal energy access with a focus on the 2030 Agenda.

This present report is the latest, thoroughly updated regional edition of the SDG 7 Regional Tracking Report. Compiled by ESCWA, it aims to help build capacity in the Arab region through access to information with the aims of strengthening proactive policy to improve energy security and enhance resilience to climate change and mainstream sustainable development goals into regional and national policy processes.

This report tracks progress in SDG 7 on affordable and clean energy in the Arab region. Progress towards SDG 7 is tracked along three main indicators:

1. Access to modern energy (Chapter 1)
2. Energy efficiency (Chapter 2)
3. Renewable energy (Chapter 3)

In addition, this report includes a separate chapter (Chapter 4) that traces the interlinkages between progress in SDG 7 and SDG 13 (climate action) in Arab countries, while Chapter 5 provides country-by-country progress and major developments in sustainable energy. Spanning 19 countries and a population of 398 million, the Arab region is characterized by vastly different development experiences, natural resource endowments, energy access and income levels. Yet, its countries also share a vulnerability to unsustainable growth patterns including in energy and to climate change.[1] Equipping their economies with sustainable energy solutions that enable socioeconomic growth, while protecting the climate and ensuring a healthy planet for future generations, will be one of the most fundamental challenges across all Arab countries in the coming decades.

1. Energy Access

1. Energy Access

Energy access is measured as the proportion of a country's population with access to (a) electricity and (b) clean fuels and technology for cooking (CFTs). SDG 7.1 tracks aggregate change in these two variables towards the effective goal of ensuring, by 2030, universal access to affordable, reliable and modern energy services. This chapter presents the main findings for the tracking period up to 2017.

Access to electricity

Main messages

- **Regional trend.** Access to electricity is, to a large degree, a bright spot in the Arab region's sustainable development agenda. The Arab region's electrification rate rose from 88.4 percent in 2010 to 92.5 percent in 2017, at an average annual electrification rate of 0.7 percentage points, making it the most electrified regional group of countries in the developing world. By 2017, electrification access was virtually universal in all but three Arab countries. Encouragingly, the decline of the region's access deficit has been accelerating in recent years. The region's population without access to electricity fell from some 40 million in 2010 to some 30 million in 2017.
- **Reaching the 2030 target.** Overall, the Arab region is on track with its target of achieving universal access to electricity by 2030. Region-wide growth in access over the period 2014–2017 averaged 1 percent, requiring further average annual growth of 0.5 percent until 2030 to reach universal electricity access. Among the Arab LDCs—which incur virtually all the Arab region's electricity access deficit—both the Sudan and Yemen are on track, with average annual growth in access between 2014 and 2017, exceeding their required growth rates for the period 2018–2030. Only Mauritania required a significant acceleration in its efforts to make access to electricity universal.
- **Key deficit countries.** In 2017, some 7.5 percent of the Arab region's population, or around 30 million people, were left behind with no formal access to any kind of electricity. Over 90 percent of the Arab region's entire access deficit in 2017 remained concentrated in the three Arab LDCs: the Sudan (17.7 million), Yemen (5.88 million) and Mauritania (2.5 million). The rest of the region's access deficit is found in Libya and the Syrian Arab Republic, both conflict-torn countries, with Libya never recovering its 100 percent access rate since 2000. Libya, the Syrian Arab Republic and Mauritania are the only three countries in which more people lacked access to electricity in 2017 than in 2010.
- **Urban–rural distribution.** The Arab region's remaining electricity access deficit is

predominantly a rural problem. Some 88 percent of Arab LDCs' urban population, but only around 50 percent of its rural population, had access to electricity in 2017. In Yemen, 98 percent of the urban population had access to electricity, versus 69 percent in rural areas. In the Sudan and Mauritania, these numbers are 82 percent for urban access, versus 43 percent rural access in the Sudan and no access at all for rural populations in Mauritania.

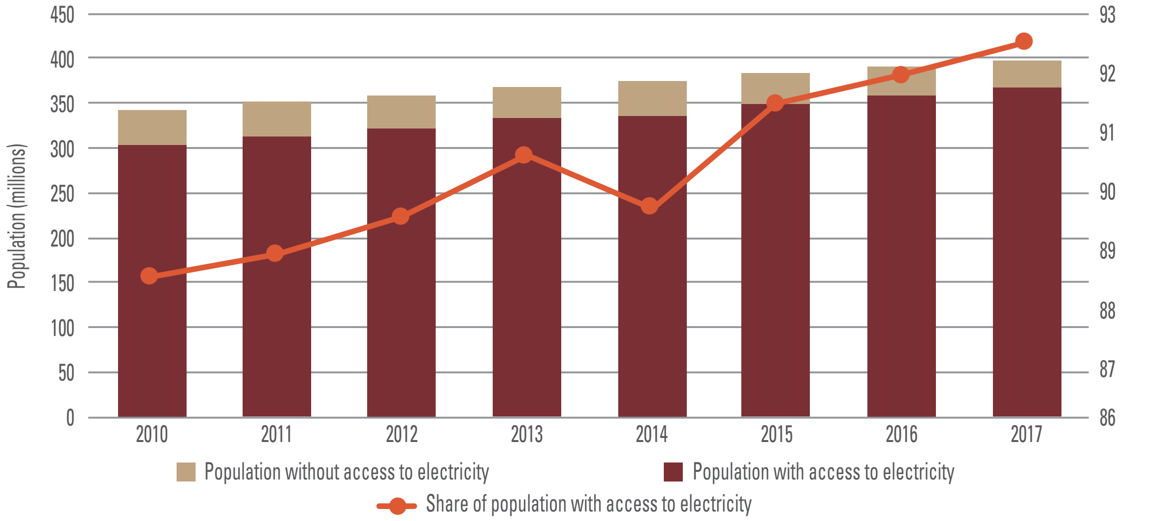
- **Conflict, instability and access to electricity.** Conflict and instability have had a highly detrimental impact on a range of socioeconomic factors in the Arab region throughout the tracking period, including electricity access. Conflicts and instability in Iraq, Libya, the Syrian Arab Republic and Yemen generated more than 6 million refugees by 2017, as well as some 11 million internally displaced persons, whose living conditions and energy access remain for the most part provisional and largely unreflected in current data. Conflict-affected countries Libya and the Syrian Arab Republic saw declining rates of electricity access over the tracking period, reflecting large-scale destruction of infrastructure that will likely challenge these countries' efforts in providing universal access to electricity to all citizens for many more years to come.
- **Affordability and reliability of electricity.** While the Arab region boasts overall high rates of electricity access, the quality of service varies significantly. During the tracking period, planned and unplanned service disruptions due to insufficient generation capacity and transmission infrastructure have been of particular concern in conflict-affected Iraq, Libya, the State of Palestine, the Syrian Arab Republic and Yemen, but also in neighbouring Jordan and, in particular, Lebanon. Similarly, electricity is not equally affordable everywhere. Jordanians, Moroccans, Palestinians and Tunisians pay on average more than 20 times the average bill in the Arab region's lowest-cost country. This affects affordability of electricity services in these countries, particularly among low- and lower-middle income groups. Many off-grid solutions such as mini-grids that offer access to remote settlements similarly remain disproportionally expensive, affecting access rates.

Are we on track?

Access to electricity is to a large degree a bright spot on the Arab region's sustainable development agenda. In spite of conflict, instability and uncertainty in many parts, the Arab region's electrification rate rose from 88.4 percent in 2010 to 92.5 percent in 2017, at an average annual electrification rate of 0.7 percentage points, making it the most electrified regional group of countries in the developing world. By 2017, electrification access was virtually universal in all but three Arab countries, with a history of near-complete electrification rates in the Gulf Cooperation Council (GCC) countries and parts of the Maghreb and Mashreq reaching back well into the 1990s. The share of populations with access has grown continuously since 1990, while the region's actual population without electricity access has—despite significant population growth—halved over the past 25 years.

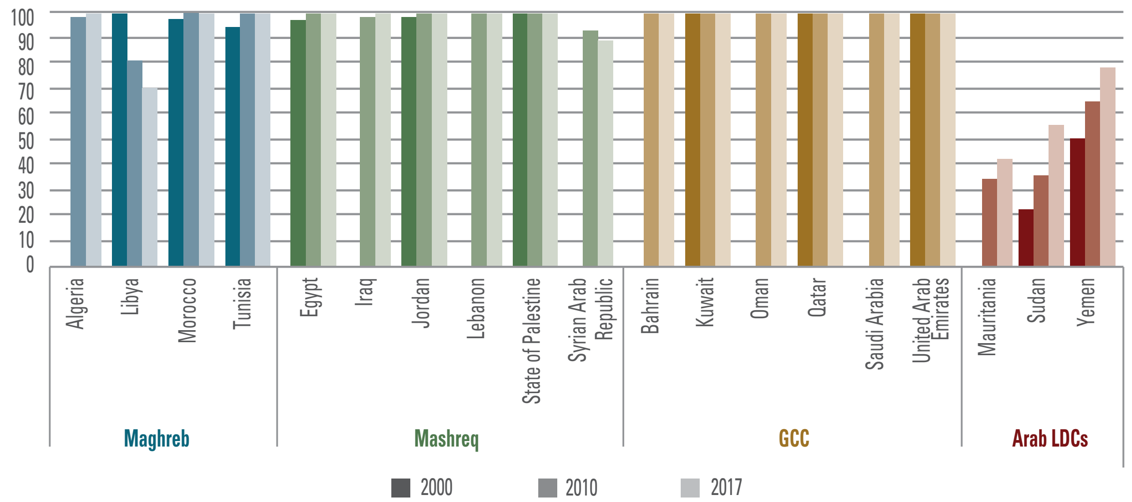
Encouragingly, the decline of the region's access deficit has been accelerating in recent years. The region's population without access to electricity fell from about 40 million in 2010 to around 30 million in 2017 with urban access slightly increasing to 98 percent (up from 97 percent in 2010), with rural access improving from 77.1 percent in 2010 to 84.5 percent in 2017. Around 10 million people gained access to some form of electricity between 2014 and 2017 alone, around 43 percent of the total number of people gaining access since 2000, underlining strong progress in closing the last gaps in access in recent years in all but a few cases. Morocco, the Sudan and Yemen account for almost all of this gain in access. The fastest growth rates in electricity access over this period are found to be in those countries with remaining access

Figure 1. Progress in population with electricity access in the Arab region from 2010 to 2017 (millions of people and share of population with access to electricity)



Source: World Bank, 2019d.

Figure 2. Electrification rates in the Arab region, 2000–2017 (percent)

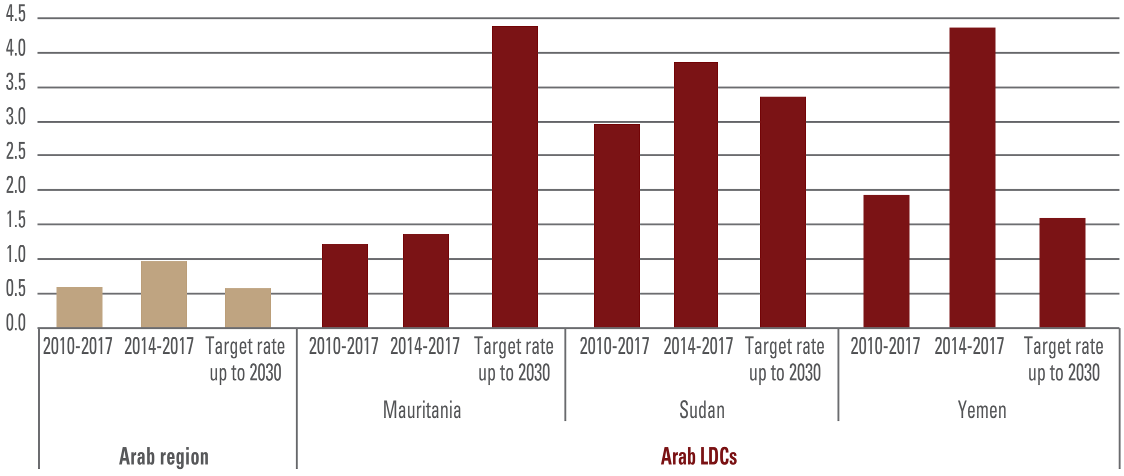


Source: World Bank, 2019d.

deficits by the beginning of the decade, i.e. Mauritania, Morocco, the Sudan and Yemen. Morocco was the last country outside Arab LDCs to eliminate its access deficit during the second half of the current decade, following more than two decades of dedicated policy efforts in rural electrification.

Despite significant, region-wide progress in formal electricity access, around 7 percent of the Arab region's population—some 30 million people—had no formal access to any kind of electricity in 2017. These data do not fully encapsulate the number of people in the Arab region who have lost secure access to electricity

Figure 3. Average annual increase in access rate to electricity (percentage points)



Source: World Bank, 2019d.

Box 1. Gaps in energy-access data

Tracking progress in access to affordable, reliable and modern energy in the Arab region is a challenging process given the significant gaps in data and access to information. Arab countries lack both basic annual national energy-access data such as electricity and CFTs, and comprehensive, regular national household surveys on energy-use patterns. As a result, even basic indicators such as access to electricity need to be generated by external bodies, such as the World Bank and WHO, through modelling based on available data points that often reach back many years. Conflicts and their effects on national access are hence poorly reflected in available data. Rural–urban differences can only be modelled using a set of assumptions based on past data points that often provide no adequate basis for reality-based access data; at best they provide an indication of how large the access gap might possibly be. Higher and lower ranges for point estimates for access to CFTs as used by WHO as shown in Section 1.2 below illustrate the considerable uncertainties behind the data available.

Lack of data also means a general lack of understanding of many important drivers of energy access. These include no harmonized, comparative data on affordability, implying how affordable energy is in different countries cannot be measured de facto; and missing national data on service reliability and the level of disruptions of electricity services, with much analysis resting on old data with many gaps. There is no gender-disaggregated data for energy access available, nor regular, national data about household energy-consumption patterns across countries, such as types of energy used and prices paid. Solid biofuel remains an important source of energy in a number of Arab countries, but its composition remains poorly understood.

Lack of qualitative and quantitative data on energy access renders tracking progress in SDG 7—particularly of access to the energy component—a patchy and incomplete exercise that can provide only a sketch of main dynamics, with many questions unanswered. The same lack of data also obstructs effective policymaking within countries, because the socioeconomic dynamics behind energy access need to be understood in order to formulate appropriate policies to improve access. This report is an opportunity to showcase available data, help identify data gaps and demonstrate how difficult it is to attain a full picture in the absence of good-quality data.

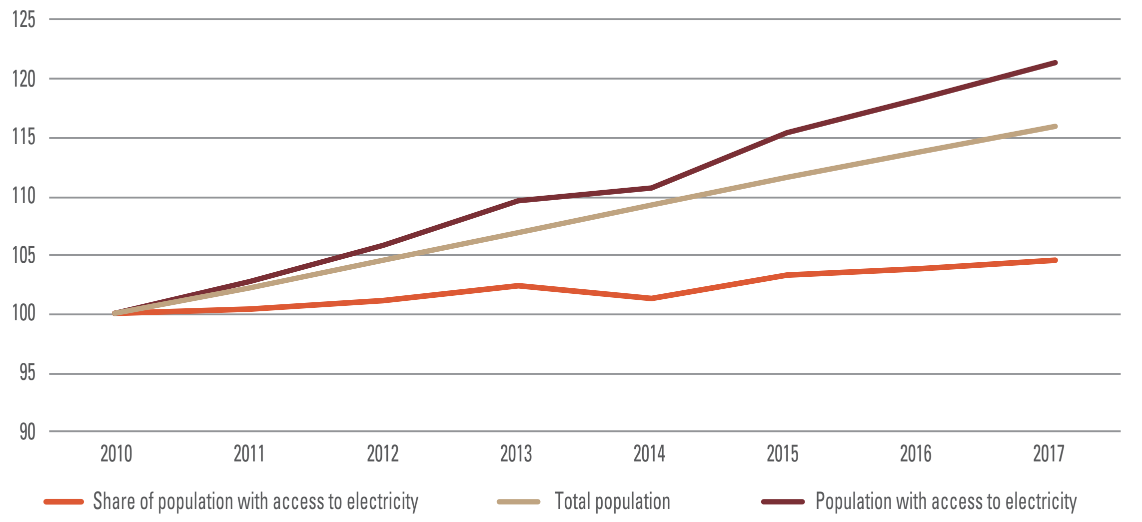
over the tracking period 2014–2017 as a result of conflict and instability. In 2017, UNHCR registered more than 7 million refugees, as well as some 11 million internally displaced persons, primarily in Iraq, Libya, the Syrian Arab Republic, and Yemen[1] with no official information concerning a majority of these people's access to modern energy. This is in addition to some 5.3 million Palestinian refugees registered by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) in 2017.[2] Of particular concern is the accuracy of electrification data for Iraq and Yemen, whose results show universal access and increased access rates, respectively, in 2014–2017, despite significant damage to electricity sector infrastructure and resulting losses in grid access to undocumented numbers of households.[3]

Overall, the Arab region is on track with its target of achieving universal access to electricity by 2030 (Figure 3). Region-wide growth in access over the period 2014–2017 averaged 1 percent, requiring further average annual growth of 0.5 percent until 2030 to reach universal electricity access. Among the Arab LDCs, which incur virtually all of the Arab region's electricity access deficit, both the Sudan and Yemen are on track, with average annual growth in access between 2014 and 2017 exceeding their required growth rates for the period 2018–2030 (Figure3). Universalizing electricity access in both countries requires significant efforts, however, at a target rate of 3.4 percent and 1.6 percent respectively. Mauritania lags behind, with little progress made over the tracking period. It must more than quadruple its current access growth rate of 1 percent until 2030 in order to electrify all households.

Throughout the region, access growth mostly surpasses population growth

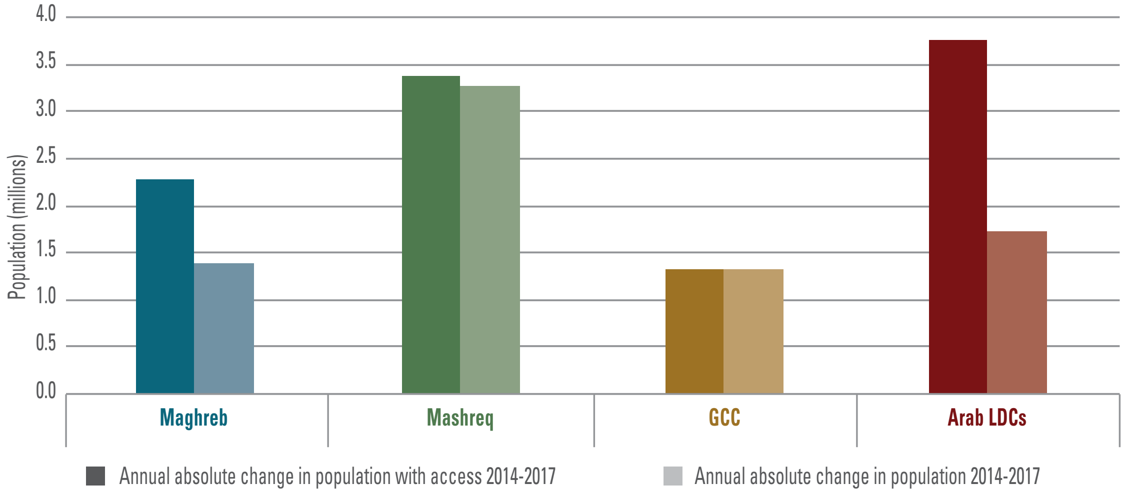
Throughout the Arab region, additional population with electricity access grew faster than population growth between 2014 and 2017. This reflects already near-universal electricity access across many parts of the region, as well as substantive progress in electrification efforts in Arab LDCs. The same period also saw a further net decline in population lacking access to electricity, reinforcing a region-wide pattern since the mid-2000s. In the Arab LDCs, which account for virtually all of the Arab region's remaining electricity access deficit, population with access grew at double the rate as population—a highly encouraging result.

Figure 4. Share of population with electricity access in urban and rural areas from 2010 to 2017 (index, 2010=100)



Source: World Bank, 2019d.

Figure 5. Annual incremental access and population growth, 2014–2017, by Arab subregion



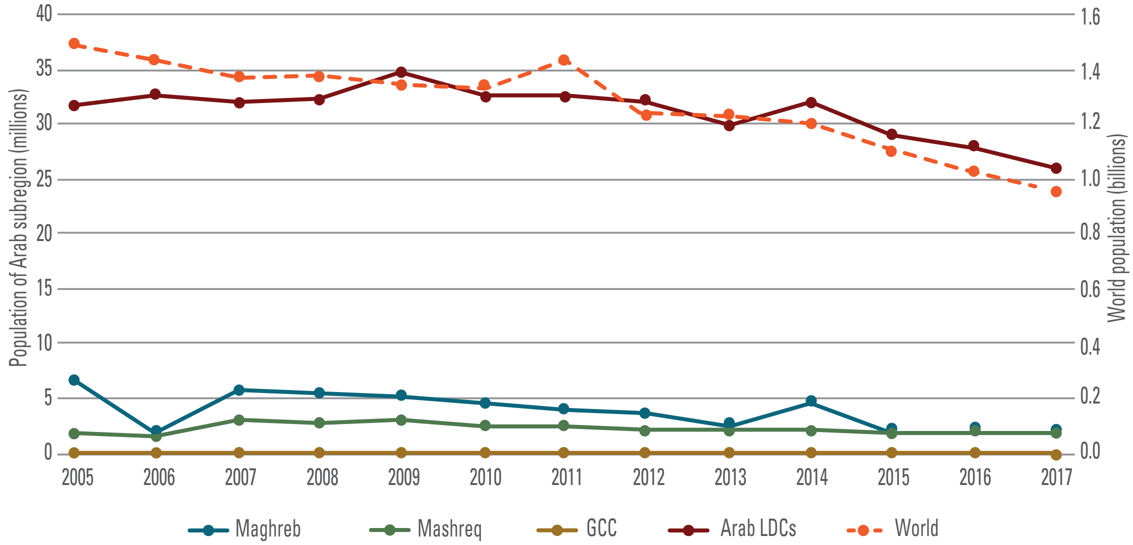
Source: World Bank, 2019d.

The overall access deficit is declining but remains acute in a small number of countries.

The Arab region has seen a consistent decline in populations without access to electricity. Since 2010, a number of Arab countries closed their remaining access gap, most importantly Morocco, but also neighbouring countries with small numbers of disconnected people in the Maghreb and Mashreq. Figure 6 and Figure 7 illustrate this significant achievement.

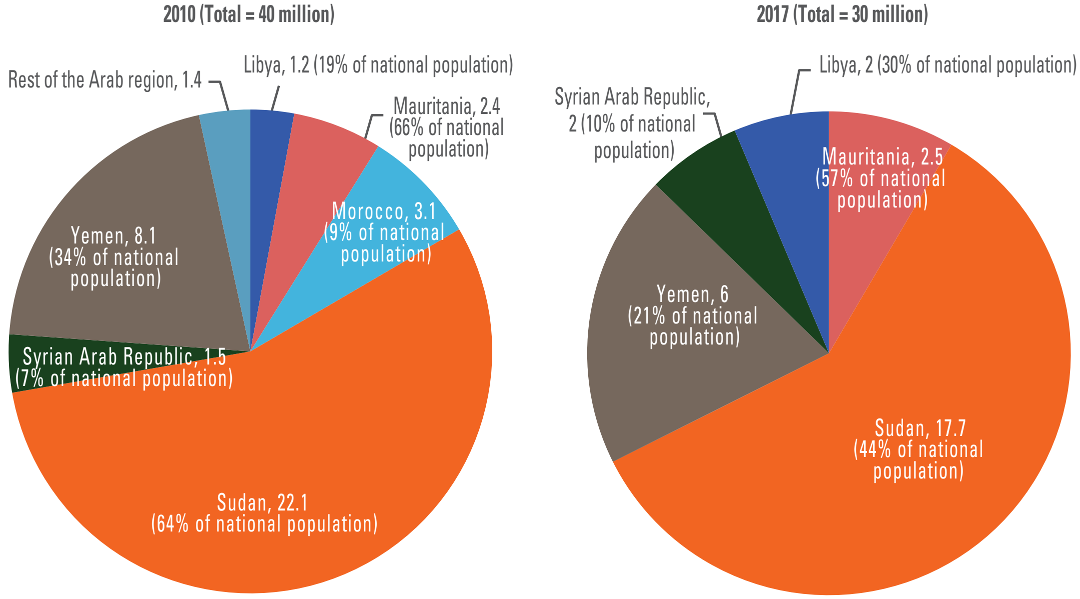
Nonetheless, the access deficit remains acute in a number of countries. Over 90 percent of the Arab region's entire access deficit in 2017 remained concentrated in the three Arab LDCs: the Sudan (17.7 million), Yemen (5.88 million) and Mauritania (2.5 million). The Sudan has one of the lowest electricity consumption levels in the world

Figure 6. Evolution of electrification access deficit (millions of people), 2005–2017



Source: World Bank, 2019d.

Figure 7. The Arab region's electrification access deficit in population numbers, 2010 and 2017



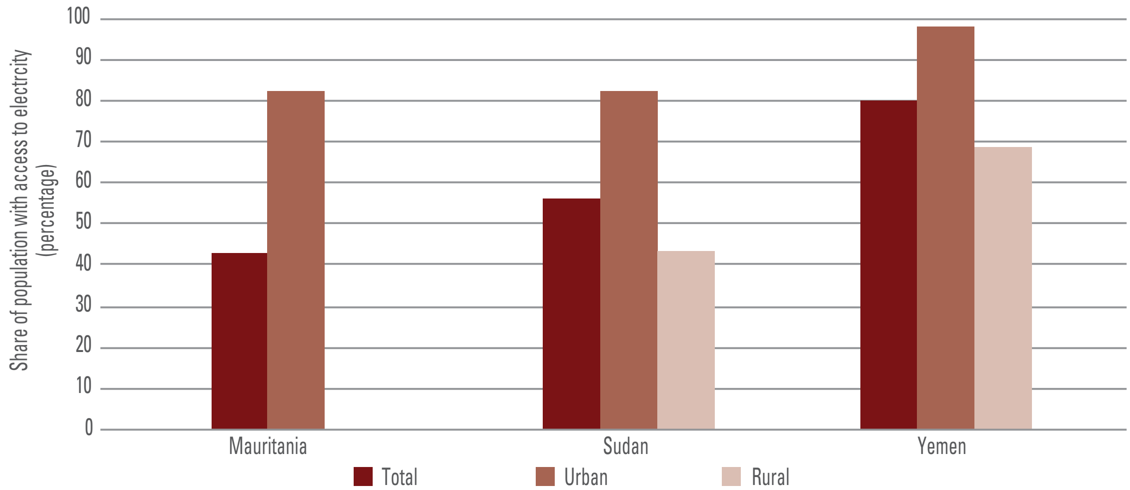
Source: World Bank, 2019d.

and reflects the ongoing development challenge of increasing rural electrification rates.[4] The rest of the region's access deficit is found in Libya and the Syrian Arab Republic, both conflict-torn countries since 2011. Libya has never recovered its 100 percent access rate since 2000. Libya, Mauritania and the Syrian Arab Republic are the only three countries in which more people lacked access to electricity in 2017 than in 2010.

Most of the access deficit remains concentrated in rural areas.

The Arab region's remaining electricity-access deficit is predominantly a rural problem. Some 88 percent of Arab LDCs' urban, but only around 50 percent of its rural population, had access to electricity in 2017. In Yemen, 98 percent of the

Figure 8. Access to electricity in the Arab LDCs, 2017 (percent)

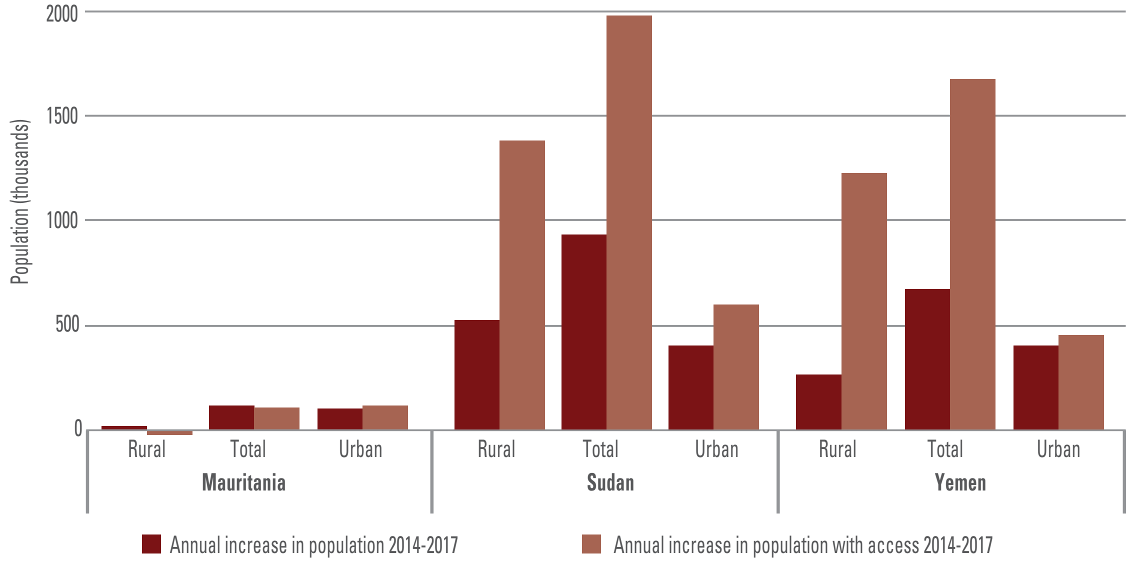


Source: World Bank, 2019d.

urban population had access to electricity, versus 69 percent in rural areas. In the Sudan, these numbers are 82 percent for urban access, versus 43 percent rural access and no access at all for rural populations in Mauritania (Figure 8). There are no disaggregated data for rural–urban electrification rates for the Arab region's two other deficit countries, Libya and the Syrian Arab Republic.

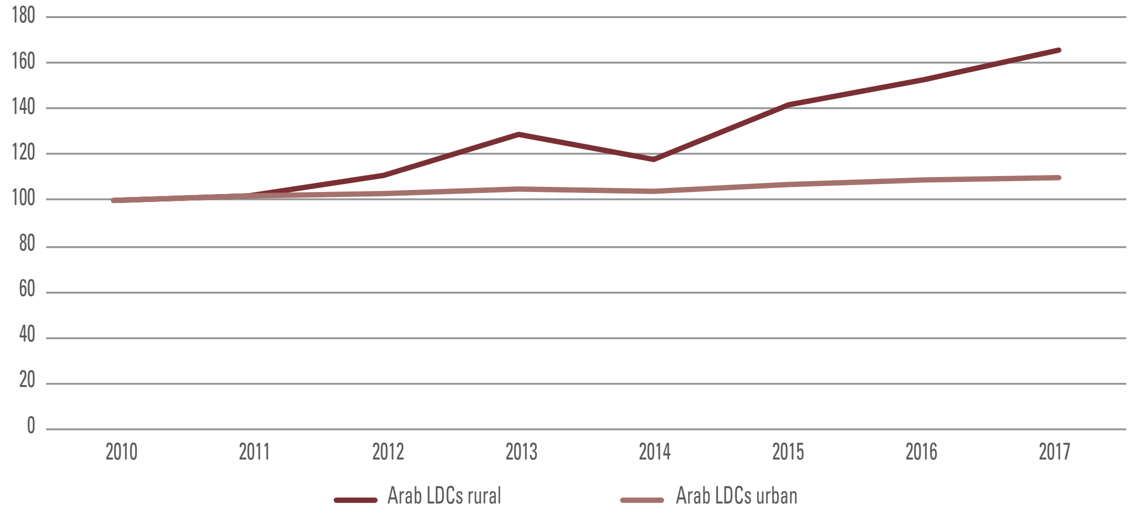
As a result of much higher access rates in urban areas, the pace of urban-access expansion in Arab LDCs has been almost constant, whereas rural access has grown fast in the Sudan and Yemen, albeit from very low rates to begin with (Figure 9). Mauritania is the only country with no positive progress in rural electrification. By contrast, its urban access rates have almost

Figure 9. Annual incremental increases in population and population with access to electricity, 2014–2017



Source: World Bank, 2019d.

Figure 10. Share of population with electricity access in urban and rural areas from 2010 to 2017 (index, 2010 = 100)



Source: World Bank, 2019d.

doubled since 2000. Geographically, urban-access deficit is more prevalent in the Sudan than in Mauritania and Yemen. This remaining rural access gap is not a niche problem; nearly half the population of Mauritania and two-thirds of the populations of the Sudan and Yemen live in rural areas, implying a large proportion of these countries' populations are left behind.

The Arab region in recent years has shown that access to modern energy benefits from the uptake of new technologies, in particular those based on renewable energy. Solar power offers an immediate opportunity for expansion of off-grid electricity access at costs that are significantly below those of conventional diesel-based generators. Solar stand-alone systems offer important access avenues to households, farmers and small enterprises, as has been demonstrated in Mauritania, Morocco, the State of Palestine and Yemen. Building on this opportunity requires national governments in countries with incomplete access to promote and open markets to solar off-grid technology, learning from past examples by providing households and businesses with access to information and microfinance, while also strengthening capacity to safeguard product quality. International funding bodies can play an important role in supporting rural electrification programmes, as is already the case in countries such as Mauritania.[5]

Conflict, occupation and instability have led to a regression in access.

Conflict has had a highly detrimental impact on affected populations. At the time of writing (2019), ongoing conflicts in the Syrian Arab Republic, Libya and Yemen, in addition to the ongoing Israeli occupation of Palestinian territory, saw continued high levels of human suffering, loss of life, and destruction. Yemen had turned into the world's most acute humanitarian crisis, while the humanitarian and refugee crisis in the Syrian Arab Republic remained, according to UNHCR, the largest in the world. In the Maghreb, since 2014, Libya had descended into civil war, compounding the suffering of the population and leading to new waves of forced internal and cross-border displacement. In the occupied Palestinian territory, Israeli measures and practices continue to negatively affect the lives of Palestinians and obstruct development. The Israeli-imposed blockade on Gaza and recurrent military offensives resulted in an ongoing humanitarian crisis and the vast destruction and deterioration of its infrastructure. UNHCR put the number of refugees from the Syrian Arab Republic and Yemen in the first quarter of 2018 at around 6.2 million, in addition to some 11 million internally displaced persons in Iraq and Libya.[6] As of April 2019, Yemen also hosted in its own right over 280,000 people seeking refuge, mainly from the Horn of Africa.[7] Some 5.3 million Palestine refugees are registered with UNRWA, many of whom have been living in refugee camps for decades.[8]

The escalation of conflict in the Arab region has also had far-reaching effects on energy access in affected countries. In Iraq, Libya, the Syrian Arab Republic, Yemen and the occupied Palestinian territory (specifically Gaza), damage to, and destruction of, national infrastructure have included power-generation plants and transmission infrastructure has contributed to the collapse of essential public services such as health, schools, secure water access and sewerage (see Box 2 for the effects of conflict on Yemen's energy supply).[9] Electricity supplies and electrical infrastructure has been targeted by conflicting parties in many of the conflicts in the region.[10] Moreover, hundreds of thousands of internally displaced people in countries such as Iraq, the Syrian Arab Republic and Yemen live in precarious settlements, including unfinished and abandoned buildings, with access only to improvised energy solutions in the frequent absence of formal access to electricity and running water.[11] Several million refugees from the Syrian Arab Republic live in refugee camps in neighbouring countries, with limited electricity access.[12] Libya and the Syrian Arab Republic saw declining rates of electricity access over the tracking period, reflecting large-scale destruction of infrastructure that will likely challenge the countries' efforts in providing universal access to electricity to citizens for many more years to come.

Box 2. The effects of conflict on electricity access and living conditions in Yemen

Despite progress in electricity access, Yemen has seen public electricity services collapse since conflict erupted in 2014. A World Bank study of 2018 suggests that, by the end of 2017, Yemen's pre-conflict electricity access rate of some 66 percent had in reality dropped to a mere 10 percent, due to extensive damage to the national grid and fuel shortages across the country.[a] The report also highlights that six out of 10 cities assessed in the second phase of the *Yemen Dynamic Damage and Needs Assessment* (DNA) were found to have no access at all to public electricity, including major cities such as Sana'a, Hodeida and Taiz. Rural and peri-urban areas, which account for around two-thirds of Yemen's population, have suffered disproportionately from a lack of access to modern energy, with pervasive fuel shortages due to the disruption of transport linkages having further exacerbated the already pre-conflict existing effects of energy poverty on the rural poor.[b]

The 2018 World Bank report assessed the impact of ongoing political conflict on Yemen's electricity sector. The study draws dire conclusions about the dismal humanitarian situation resulting from the loss of electricity access to large parts of the country for prolonged periods of time. Among other things, it concludes that:

> "Restoring power supply to productive users is critical to alleviate the dire humanitarian situation in the country (…). Already before the conflict, the lives of the many Yemenis, especially in rural and peri-urban areas, were characterized by lack of access to basic infrastructure and service facilities. Impacts of the collapse of public electricity have been devastating: Electricity is becoming a binding constraint for critical service facilities that do not have the means to invest in alternative energy sources, including health facilities and vaccine cold chain, water supply and sanitation, food supply, banking services and more. Even where diesel generators have been adopted for emergency power supply during the conflict, fuel shortages are leading to severe constraints to service delivery, including in the water and health sectors where prolonged power outages are contributing to the spread of the Cholera epidemic. Businesses also cite electricity shortages as the second most important constraint after conflict and political instability. Continued lack of electricity access is likely to contribute to a decrease in productivity, deterioration of the business environment, and reduction in the country's gross domestic product (GDP).
>
> (…) Particularly in rural and peri-urban areas, the collapse of electricity and fuel supplies has severely impacted employment and household incomes due to the dependence on agriculture and energy-intensive groundwater extraction for irrigation. Immediate effects on household budgets of the lack of electricity supply also include the increased dependency on scarcely available and expensive liquid fuels. Social impacts include limits to children's ability to study in the evenings and limited functionality of schools. The collapse of power supply and night-time lighting has also added to security concerns, especially among women for whom the lack of lighting on the way to shared latrines exacerbates risks to gender-based violence (GBV). Due to the lack of electricity for water pumping, many rural households have been forced to travel long distances to fetch water – a task that falls disproportionately on women and children."

Source: World Bank, 2018a

[a] World Bank, 2017b; 2018a.

[b] World Bank, 2018a.

Neighbouring countries have also been affected by conflict through the influx of refugees. Jordan and Lebanon in particular have seen demand for energy along with other public services increase significantly in recent years.[13] As of March 2019, Jordan and Lebanon hosted some 660,000 and 945,000 Syrian refugees, respectively. The Lebanese Ministry of Electricity and Water estimates the total cost of providing additional energy services to refugees at an average of 370 million USD/year between 2014 and 2018, equivalent to 1.85 billion USD over the five-year period,[14] while the Jordanian Government estimates these costs to be around 119 million USD in 2017, down from 247 million in 2014, with an estimated total bill of 704 million USD for the tracking period. The fast increase in electricity consumption in both countries has also proved challenging for both countries' electricity sectors in capacity terms, affecting service quality and reliability.[15]

In addition to these acute conflict situations, the State of Palestine continues to suffer from chronic power sector problems that relate to the long-term Israeli occupation and its practices. During the tracking period, this situation further deteriorated, with Palestinians not being allowed to construct its own power plants, reinforcing its dependence on high-cost foreign imports of electricity from Israel. Solar rooftop electricity has grown in importance over the tracking period, with the State of Palestine being the Arab region's second largest consumer of solar power, based entirely on stand-alone systems (see Chapter 3). While still comparably costly, solar rooftop systems in the State of Palestine are seen as playing a valuable role as an electricity safety net to increase the resilience of the Palestinian electricity system and help ensure that critical humanitarian needs can be met.[16] This is particularly true for Gaza, where 16–20 hours of scheduled electricity outages each day are chronically problematic.[17]

Electricity access does not mean reliable electricity services.

While the Arab region boasts overall high rates of electricity access, the quality of service varies significantly. During the tracking period, planned and unplanned service disruptions due to insufficient generation capacity and transmission infrastructure were of particular concern not only in countries affected by conflict, occupation and instability—Iraq, Libya, the State of Palestine, the Syrian Arab Republic, Yemen—but also in countries affected by the spillover effects of conflict, such as Jordan and Lebanon. Lebanon having itself suffered from chronic utility-sector problems long preceding the conflict in the Syrian Arab Republic saw these problems exacerbated by the dramatic increase in electricity demand by more than one million Syrian refugees who fled to Lebanon during the tracking period.[18] In the conflict-torn Syrian Arab Republic, average electricity services last for around nine hours per day;[19] in the State of Palestine, electricity is supplied on average for eight hours per day.[20] In Yemen, a 2018 United Nations Development Programme (UNDP) survey found 70 percent of respondents considered electricity provision to be "very" or "somewhat" incapable of meeting needs.[21] Arab LDCs Mauritania and the Sudan also suffer from service disruptions.[22]

Electricity service disruptions are a problem for households, but also for businesses, medical facilities and the public sector, all of which rely on functioning electricity services. Survey data collected by the World Bank reveal that more than 50 percent of businesses in the Middle East and North Africa reported some interruption to electricity services in the years prior to the tracking period, when data availability mostly ends.[23] Some 80 percent of Egyptian businesses reported electricity outages in 2013, although this number fell to around 38% by 2016; with 73 percent of businesses in the State of Palestine (2013), 77 percent in Iraq (2011), and above 95 percent in Lebanon and Yemen (2013).[24] Given the fragile political situation in most of these countries during 2014–2017, it is likely that the situation has since deteriorated, rather than improved.

Conflict damage to infrastructure is an important but not the only reason for service disruptions. Disruptions to electricity services are often linked to long-term underinvestment, which results in poorly maintained infrastructure, insufficient generation and transmission capacity, and high operation costs due to fuel and inefficient technology costs. Universal subsidies on fuel and electricity in a number of Arab countries have historically contributed to the often desolate financial situation of national utilities, while national legislation for many decades barred the utility sector from the entry of alternative utility providers.[25] Related problems are ineffective bill-payment collection; and electricity theft through illegal connections.[26] Conflict and instability have worsened this situation considerably in affected countries, through the destruction of infrastructure, including power-generation plants and transmission lines.

Affordability is linked to service quality and the rate of access.

While the Arab region's electricity prices remain overall low in comparison to the global level, this does not mean electricity is everywhere equally affordable. Figure 11 uses a proxy value of the average electricity bill for 750 kWh/month consumption versus GDP per capita at current USD as a proxy for average annual household income.[27] The figure shows a considerable range of average bill ranges versus income levels.

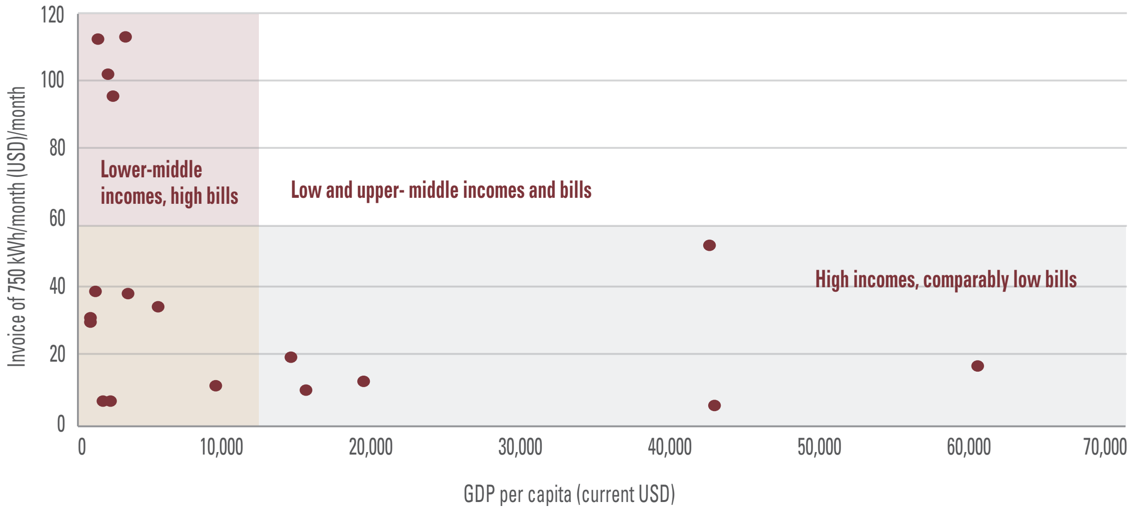
Particularly in the high-income Gulf Cooperation Council (GCC) countries, the average cost of electricity services remains extremely low relative to per capita incomes. The lowest cost of electricity in the Arab region is found in Kuwait, which has among the highest per capita incomes in the world. The only outlier in this group of countries is the United Arab Emirates, whose average bills are more than 10 times higher than the lowest-cost country in the group. Electricity in the other GCC countries remains heavily underpriced, reflecting the historical practice of electricity as a social commodity rather than economic justification, at least at household level.[28] In the absence of dynamic tariffs, all consumer groups in GCC countries outside the United Arab Emirates benefit from low-cost electricity, including high-income households, businesses and industrial users.

Average bills are moderate, although mostly higher than in the GCC, in a number of middle-income countries. The lowest average costs for electricity within this group of countries are found in Iraq, Libya and the Syrian Arab Republic, while costs in Algeria, Egypt, Lebanon, the Sudan and Yemen are more than double those in lowest average-cost countries, in spite of similar or lower income ranges. The Sudan and Yemen still have comparably low electricity costs, but very low per capita income levels, in addition to high numbers of households without grid-access. Low electricity prices in these countries are a major contributing factor to the lack of capacity for investment in more grid access through infrastructure expansion, underlining the highly problematic nature of electricity subsidies. Extremely low household incomes in many areas outside urban areas add to a lack of incentive to invest in the expansion of grid access, for instance in Mauritania, where households in many rural communities are not expected to be able to pay for electricity no matter how low the price of electricity from the grid.[29]

The Arab region's highest average tariffs are found not in high- but in lower-middle income countries. Jordanians, Moroccans, Palestinians and Tunisians pay on average more than 20 times the average bill in the Arab region's lowest cost country—Kuwait—and still more than double average rates in countries such as Algeria, Egypt and Lebanon, with similar or higher per capita incomes. Palestinians do not determine the price of their electricity themselves, but by the source of their imports, primarily Israel. The average bill for 750 kWh—enough to supply a fully electrified and heated household in Europe or North America—is hence not affordable for the average household in these countries given comparably low incomes. Considerably low per capita electricity consumption rates in Morocco and the State of Palestine partially reflect the high cost of electricity.[30]

The price for grid-based power does not automatically reflect reliable electricity services in many Arab countries. Chronically

Figure 11. Affordability of electricity for households in the Arab region, 2016



Notes: No data for Mauritania available.
Source: World Bank, 2019b; Arab Union of Electricity, 2016a.

unreliable network electricity supply and frequent disruptions to services, as discussed above, create vast additional costs to households and businesses in several Arab countries, affecting affordability of secure electricity supply. In Iraq, grid-based electricity accounted for more than 80 percent of the electricity consumed by households in 2018, yet, as a recent IEA report finds, it makes up a small share of consumers' electricity bills. Neighbourhood generators fill in for frequent service disruptions to allow homes, health clinics, schools, government offices and businesses to continue to function, but at considerable additional cost. The IEA estimates that neighbourhood generators currently provide some 10 terawatt hour (TWh) of electricity to end-users, implying households could be paying more than USD 4 billion for additional electricity services. The report further argues that

> "Despite efforts to provide a progressive tariff scheme to households—intended to make electricity more affordable for low-income households—the average electricity price paid per kWh of consumption is relatively constant across consumption levels due to the large role of expensive neighbourhood generation."[31]

The IEA further concludes that "enforcing existing tariff regulations for neighbourhood generators would cut the electricity bills for most households by two-thirds" and that, if successfully applied to all neighbourhood generators, "this would reduce the associated cost to consumers to less than USD 1.5 billion".[32] Lebanon has been facing similar, chronic problems in providing reliable electricity services for many years, predating the additional strains placed on the sector since the inflow of large numbers of refugees from the neighbouring Syrian Arab Republic since 2012.[33]

Many off-grid solutions such as mini-grids that offer access to remote settlements similarly remain disproportionally expensive. In Mauritania, the cost of electricity generated by the mini-networks serving rural areas was estimated at an average of USD 0.54/kWh in 2014, against USD 0.16/kWh for the network managed by the Mauritanian Electricity Corporation.[34] Most off-grid solutions remain based on diesel fuel, with the cost of solar photovoltaic-based systems having become increasingly cost-competitive, but remaining expensive compared to grid-based power (see Chapter 3). Expensive off-grid solutions often feed into a vicious circle of lack of access through lack of infrastructure and

Box 3. Gender and access to modern energy

Increased gender equality and socioeconomic progress are closely interlinked. Progress in SDG 7 supports greater gender equality, while the lack of access to electricity and CFTs in turn is a significant obstacle to gender progress, as women are disproportionally affected by the negative health implications of low-quality cooking fuels, missing access to medical services due to lack of electricity in rural areas and the opportunity cost of time spent on collecting fuelwood and other traditional sources of energy in the absence of modern energy facilities.[a]

Current data available throughout the Arab region do not include systematic gender-disaggregated data. This is a significant shortcoming that affects the way we can quantify the effects of progress, or lack thereof, in SDG 7 on gender equality. It also limits the way policymakers, businesses and local communities can formulate sustainable energy solutions that leave no members of society behind, more so given that the voices of women, as of children, are less frequently heard in policymaking.

A study from 2016 that includes data of a household survey in Yemen confirmed the many negative consequences of declining access rates to electricity and modern cooking fuels from womens' perspectives as a result of the ongoing political conflict in the country, including: increased food insecurity due to lack of options to refrigerate food; a dramatic worsening in medical services due to lack of health clinics' ability to refrigerate vaccines and provide other life-saving services; negative impacts on children's ability to study as a result of lack of lighting; and an increasingly precarious security situation for women exacerbated by lack of lighting, increasing the risk of gender-based violence.[b]

There are no harmonized data available to capture microdata for Arab countries' electricity access at household-level, such as on how access varies between rich and poor, and between male- and female-headed households. The World Bank's Global Poverty Working Group Database (GPWG-DB) does, however, offer data for a limited number of African countries, including the Sudan.[c] The data is based on a National Baseline Household Survey of 2009, prior to the separation between the northern and southern regions, meaning the data does not reflect the situation in the Sudan today. The Sudan's 2009 data confirm a strong convergence of access to electricity with male-headed households, suggesting that the lack of electricity access is far more precarious in female-headed households. This may converge with lower-income levels of female-headed households, although no data exist to solidify this conclusion. The case illustrates how limited our understanding of the gender dimension is within the energy nexus owing to a lack of available data.

Figure A. Access by quintiles of household welfare

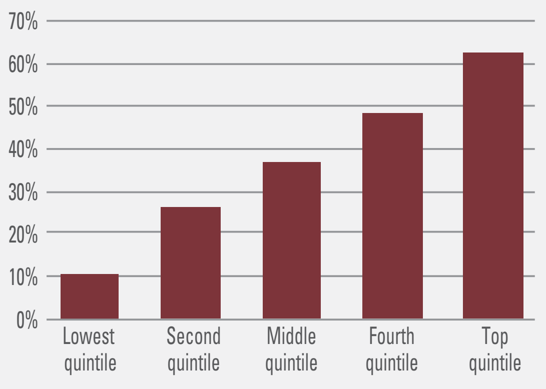
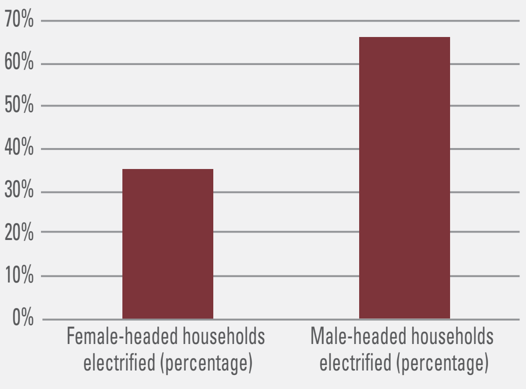


Figure B. Access by gender of head of household



Source: World Bank's Global Poverty Working Group Database (GPWG-DB)[d]

[a] For example: United Nations Development Programme, 2013b; Gonzalez Pijuan, 2018; Clancy, undated. See also ESCWA, 2019a.

[b] Oxfam International, 2016. See also ESCWA, 2019a.

[c] GPWG-DB is a World Bank internal database that enables access to the most recent household survey data across World Bank Global Practices.

[d] World Bank, 2019c.

low incomes, making alternatives to grid-based electricity unaffordable, which, in turn, reduces incentives for any grid expansion to areas where customers can realistically not afford electricity. The consequences of continued undersupply of electricity in rural areas also include continued pressure on cities through rural–urban migration by those seeking better opportunities.

Access to clean fuels and technologies for cooking

Main messages

- **Regional trend.** Access to CFTs is encouragingly high in the Arab region. In 2017, 14 out of 19 countries had access rates above 95 percent, as in the case of electricity with a long history of high access rates. Region-wide access to CFTs virtually stagnated, with very modest growth from 89 percent in 2010 and 89.4 percent in 2015 to 90.3 percent in 2017. The overall access deficit in 2017 of 37.5 million people is considerably larger than the access deficit for electricity. This indicates that CFT access still lags behind electrification in the effectiveness of available policies to make access universal.
- **Reaching the 2030 target.** After the tracking period, the challenge of closing the Arab region's CFT access deficit has become larger rather than smaller. With high population growth and slow progress in increasing the share of access over the tracking period, the annualized growth rate in CFT access in the Arab region between 2015 and 2017 will need to speed up more than six-fold over the period until 2030 to close this gap.
- **Key deficit countries.** Some 38 million people lacked access in the Arab region in 2017, most of them in the Arab LDCs Mauritania, the Sudan and Yemen. The Sudan alone accounts for almost 23 million people without CFT access for almost two-thirds of the Arab region's overall access deficit in 2017 and is therefore also one of the world's key deficit countries. Yemen's and Mauritania's access deficit broadened by contrast, with more than 2 million in Mauritania and 10 million in Yemen lacking access.
- **Urban-rural distribution.** As in the case of electricity, the access deficit for CFTs is far more pronounced in rural areas than in cities. In key deficit countries Mauritania, the Sudan and Yemen, rural access lags behind urban access by one-third; in Mauritania, some 46 percent of urban but only 21 percent of rural households had access to CFTs in 2017. There was also an additional access deficit in a number of conflict-affected and neighbouring countries that is not currently captured by our data.
- **Conflict and access to CFTs.** As in the case of electricity, conflict and instability have had a detrimental effect on access to CFTs. Reduced access to electricity has increased the demand for liquid fuels in Iraq, Libya, the Syrian Arab Republic and Yemen, leading to shortages and surging prices that have placed even liquid fuels out of many household budgets, even where they are still available. The result has been an increasing use of other available alternatives, including fuelwood, kerosene and plastic waste, with significant implications for public health, socioeconomic living conditions and the local environment. This reinforces concern about the highly detrimental effects of conflict and instability on the region's progress across all SDGs.

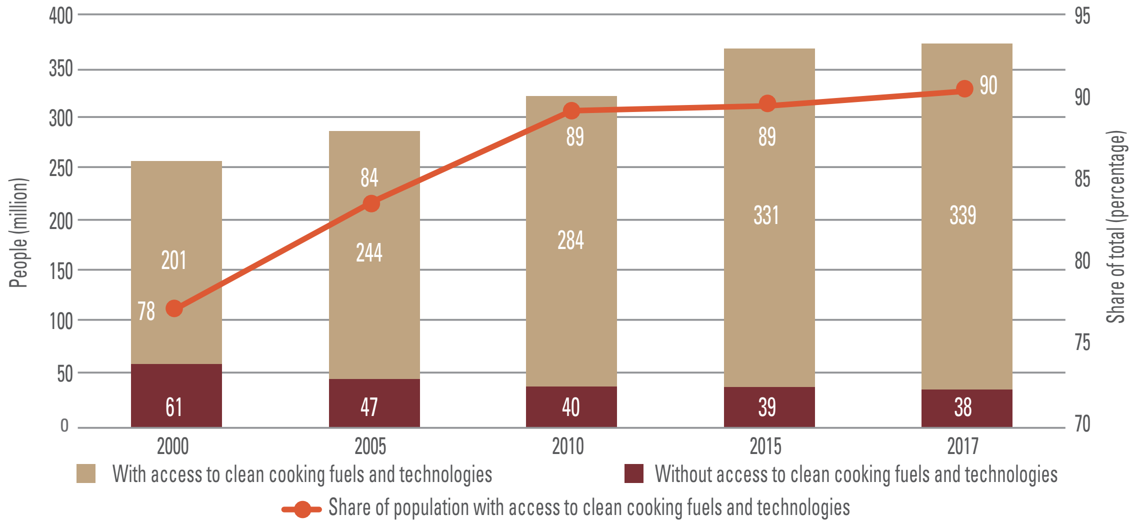
Are we on track?

Overall, access to CFTs is encouragingly high in the Arab region. In 2017, 14 out of 19 countries had access rates above 95 percent, as in the case of electricity with a long history of high access rates.[35] In 2017, the total access deficit in the Arab region affected around 38 million people, considerably larger than the access deficit for electricity. This number does probably not capture the entire access deficit, as the modelled nature of data on CFT access in the absence of systematic national survey data limits the ability of data results to fully reflect changes to access as a result of conflict and instability, while limited data available on rural access that further complicates modelling. No numbers are available for any years for Lebanon and Libya, both countries affected by conflict, either indirectly (Lebanon) or directly (Libya). Lower WHO estimates suggest additional gaps in rural areas in Egypt, Iraq, Jordan, Morocco and the Syrian Arab Republic. Even without this probable additional number of people lacking access, these numbers indicate that CFT access still lags behind electrification in the effectiveness of available policies to make access universal.

Of concern in the area of CFT access throughout the tracking period is that growth in access has largely been stagnating. Region-wide access to CFTs grew at a slow average annual rate of 0.22 percent since 2010, driven primarily by improvements in access rates in Mauritania and the Sudan, which account for a large share of the region's access deficit. The share of the Arab region's population with access to CFTs grew modestly from 89 percent in 2010 and 89.4 percent in 2015 to 90.3 percent in 2017. The results reflect comparably slow growth in the share of access in all deficit countries, and effectively stagnating access rates in Yemen since the escalation of political conflict in the country since 2011. In Arab deficit countries, this is a discouraging result which highlights the need for far greater effort to close the gap in CFT access with its related negative consequences on socioeconomic development.

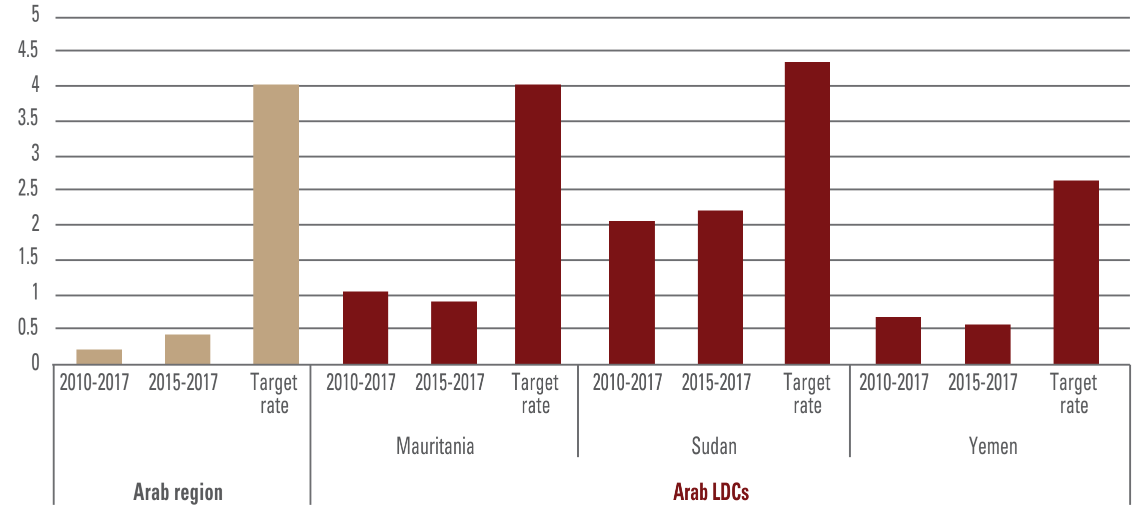
During the tracking period, the challenge of closing the Arab region's CFT access deficit has become larger rather than smaller. With high population growth and slow progress in increasing the share of access over the tracking period, the annualized growth rate in CFT access in the Arab region between 2015 and 2017 will need to speed up more than seven-fold over the period until 2030 to close this gap and achieve SDG 7.1.2. ("universal access to affordable, reliable and modern energy services"); Mauritania's growth rate will need to rise four times; the Sudan will need to double its growth rate; and Yemen will need to quadruple its rate until 2030 (Figure 13).

Figure 12. Progress in clean cooking access from 2000 to 2017



Source: World Health Organization, 2019.

Figure 13. Average annual increase in access rate to clean cooking (percentage points), Arab region and Arab LDCs



Source: World Health Organization, 2019.

Box 4. Cooking fuels used in the Arab region

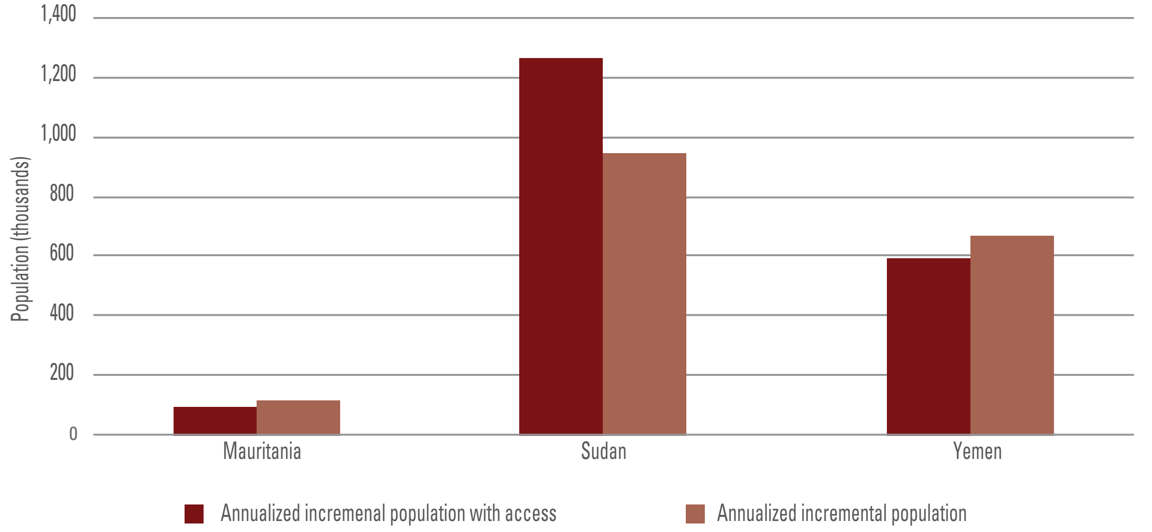
A large variety of different types of fuels used for cooking exist in the Arab region, in particular in the case of traditional solid biofuel. The most common fuel type is nowadays liquefied petroleum gas (LPG), in many households using an LPG stove. A number of countries—for instance Jordan and Morocco—have shielded LPG from fuel-price reform efforts over the tracking period in an effort to protect the affordability of LPG, and hence household access to LPG as a relatively clean and efficient fuel. Electricity is used in some cases for cooking. Less ideal liquid fuels include diesel, gasoil, petrol and kerosene, the latter being widely used in rural areas in a number of Arab countries. Besides liquid fuels, Arab countries use a wide variety of solid fuels, the choice of which depends on local availability and prices. Options include charcoal, wood and olive-cake briquettes, olive cake by-products, crop and forestry residues, waste wood, municipal sewage sludge, animal fat and slaughterhouse residues, yellow grease and household waste.

Source: ESCWA, 2019b.

Population growth has slowed access growth in some countries over the tracking period

Not in all deficit countries did increasing access rates translate into fewer people without access. Among the Arab LDCs, only in the Sudan did access growth exceed population growth, implying 896,000 people more had access in 2017 than in 2015. In Mauritania and Yemen, on the other hand, high population growth implied that small gains in percentage access rates did not imply a reduction in the absolute number of people lacking access. In Yemen, an additional 225,000 people more lived without CFT access in 2017 than in 2015; in Mauritania, the number of people without access increased by a few thousand. Countries where access is likely to have diminished as well, but where no sufficient data are available, include conflict-torn Libya

Figure 14. Annual incremental access and population growth, in the Arab LDCs, 2015–2017



Source: World Health Organization, 2019.

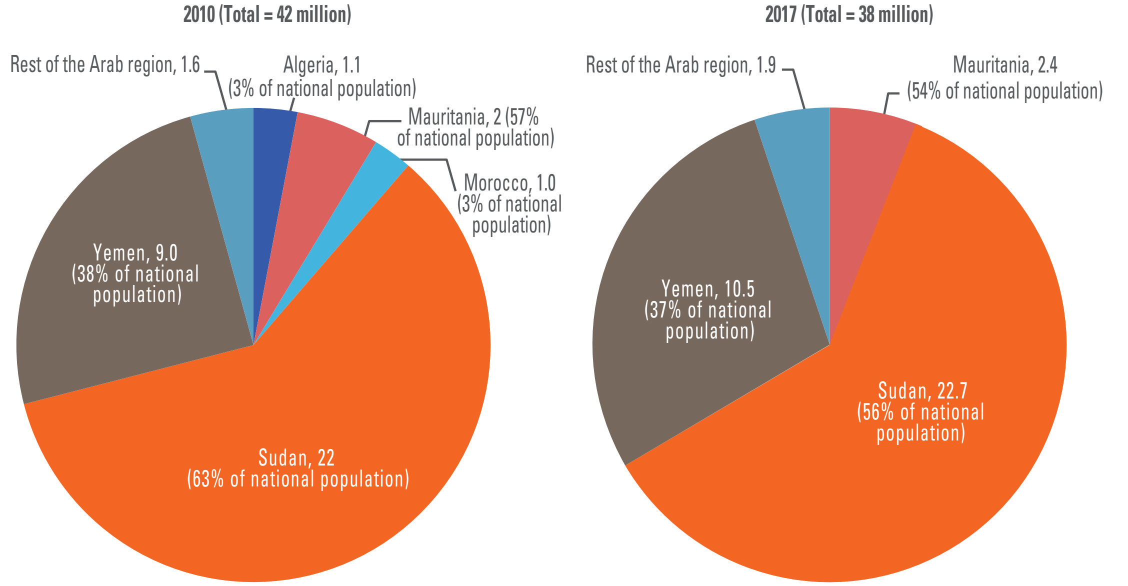
and the Syrian Arab Republic, while the energy access situation of refugees in neighbouring countries remains largely undocumented and therefore unreflected in our current data. Yemen's data, too, must be seen as problematic in view of substantial conflict-related losses to CFT access that are not well represented in the available data.

Arab LDCs account for virtually the entire region's access deficit

Some 38 million people lacked access in the Arab region in 2017, most of them in Arab LDCs (Figure 15).[36] Net growths in population numbers with access since 2010 were largely concentrated in other fringe countries, such as Algeria, Egypt, Iraq and Morocco, which have since been able to largely close their remaining access deficit. By contrast, the CFT access deficit remains highly problematic in the LDCs. Gains in access rates have not been able to reduce the actual number of people without access: on the contrary, almost 3 million more people lacked access in 2017 than in 2010 (Figure 14). Yemen's access rates are likely to be lower than represented here owing to the intensifying conflict since 2010, implying the number of people without access in 2017 is likely much higher (see also Box 2). Reversing progress in 2015–2017 as opposed to earlier progress highlights the tracking period was no success for CFT access in key deficit countries.

The Sudan remains the region's largest deficit country by population size (Figure 15). In 2017, a total of 23 million people lacked access to CFTs in the Sudan alone, even though the total number of people without access had actually decreased by almost 2 million since 2010. The Sudan's comparably large population and high access deficit also makes it one of the world's 20 largest access-deficit countries for CFTs.[37] Yemen's and Mauritania's access deficit broadened by contrast, with over 2 million in Mauritania and 10 million in Yemen lacking access (Figure 15). If WHO's lower-bound confidence interval is used, these numbers further increase, with another 6 million in the Sudan, 1.4 million in Mauritania and 1 million additional people lacking access in these countries. This would be in addition to at least some 14.4 million more people lacking access in Egypt, Iraq, Jordan, Morocco and the Syrian Arab Republic.[38] With portions of the refugee population and some in conflict areas not included in the available data, this number is more likely to be higher in reality.

Figure 15. The Arab region's clean cooking access-deficit in population numbers, 2010 and 2017

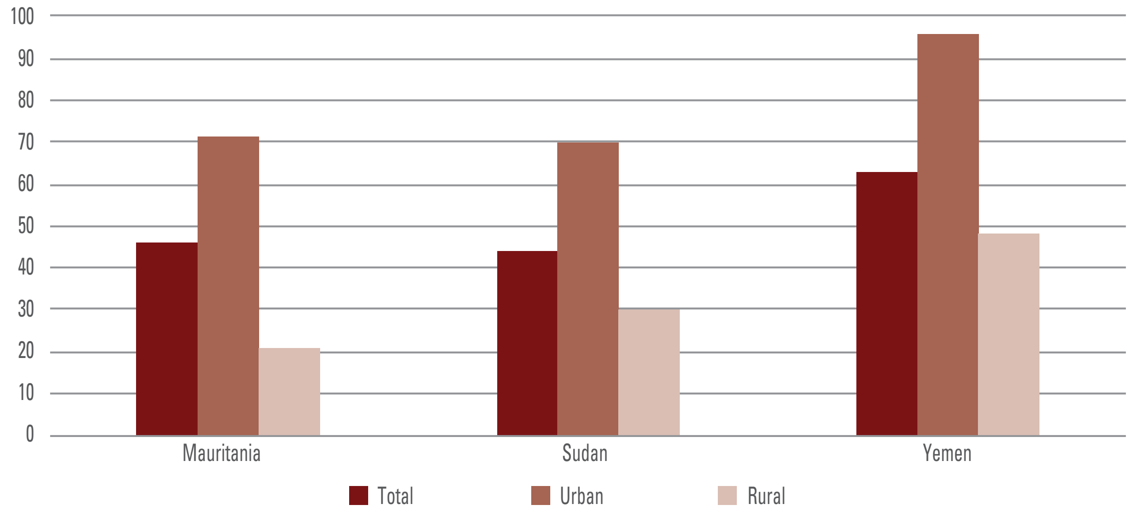


Source: World Health Organization, 2019.

The urban–rural divide remains strong in key deficit countries

As in the case of electricity, the access deficit for CFTs is far more pronounced in rural areas than in cities. In key deficit countries Mauritania, the Sudan and Yemen, rural access lags behind urban access by one-third; in Mauritania, some 46 percent of urban but only 21 percent of rural households had access to CFTs in 2017 (Figure 16). This is based on WHO's point estimates with a wider band of estimates that sees rural access going down to 8 percent in the Sudan and 7 percent in Mauritania at the lower point estimate.[39]

Figure 16. Share of population with access to CFTs in Arab LDCs (percent), 2017



Source: World Health Organization, 2019.

WHO's lower interval estimates also include rural access deficits in Egypt, Iraq, Jordan, Morocco and the Syrian Arab Republic. The presence of a considerable range of estimate points for these data reflects continued data deficits that particularly concern rural areas in these countries.

Political conflict has contributed to slower progress

As in the case of electricity, conflict and instability have had a detrimental effect on access to CFTs. Reduced access to electricity has increased the demand for liquid fuels in Iraq, Libya, the Syrian Arab Republic and Yemen, leading to shortages and surging prices that have placed even liquid fuels beyond the budget of many households, even where they are still available. In Yemen, the price of cooking gas reportedly increased by 66 percent in 2018, compared to pre-conflict times, making higher-quality liquid fuels unaffordable to many households.[40] Many more households have since begun to resort to more polluting fuels such as kerosene for lighting, and many women were reportedly resorting to cooking with plastic, with severe effects on indoor pollution.[41] In parts of the Syrian Arab Republic, too, reports indicate many have resorted to converting plastic into fuel, sparking a rise in respiratory conditions.[42] These developments are unlikely to be fully captured in currently available data.

Policy implications

Despite positive progress in regional electrification and access to CFTs, the Arab region faces many challenges in achieving SDG 7. The tracking period has seen important progress in several Arab countries' endeavours to make access to modern energy universal, closing remaining gaps. Not everywhere has this been equally successful, leaving behind a smaller yet significant share of the populations of countries with incomplete access, in particular in rural areas. Arab LDCs continue to face perhaps the greatest challenge in the region, given the continued disconnect of large portions of their rural populations from even basic electricity, with far-reaching effects on sustainable development across different indicators. In addition to electricity access, service reliability in a number of countries remains poor and has been worsening significantly in the face of conflict in an increasing number of Arab countries.

The unparallelled escalation of conflict and instability in Iraq, Libya, the Syrian Arab Republic and Yemen since 2014 has had devastating effects on energy access in the Arab region. The systematic destruction of infrastructure and institutions in these countries, coupled with the loss in human life, talent and opportunities for a whole generation to come, was a step backwards, rather than forwards. Lack of secure, clean and affordable energy here holds many debilitating consequences for millions of people, including access lost to basic health services, education, sanitation and, ultimately, economic opportunities. The close link between energy and economic opportunities many of those protesting in Arab streets in 2010/2011 were hoping for highlights the high degree of vulnerability current conflict inflicts on the Arab region as a whole. Current data inadequately capture the implications of this.

The increasing number of refugees and displaced people in the Arab region poses a challenge to secure access to electricity for all. This crisis affects the entire Arab region, suggesting urgent, comprehensive and dedicated action by all to help in the reconstruction and rehabilitation of those countries that have been suffering from conflict and to assist those countries affected by the spillover effects of conflict, including hosting millions of refugees from neighbouring countries. Progress in CFT access lags significantly behind that in electrification, with conflict having reversed progress made a decade earlier in a number of conflict-affected Arab countries and their neighbours. The parallel breakdown in electricity services in a number of countries—much of which remains probably underrepresented by our data—has led to a further deterioration of CFT access, leading to severe health consequences and environmental destruction as part of the region moves backwards on the energy ladder.

Beyond acute conflict situations, many Arab countries' utility sectors face considerable long-term challenges that require sustainable long-term solutions. These challenges include considerable inefficiencies due to decade-long practices of state-centred utility provision, inefficient subsidies, underfunded national utilities in the absence of any meaningful competition on utility markets. The result is that current operating models in many Arab countries fail to address issues of affordability, as well as long-term financial and environmental sustainability. These problems highlight the need for reform in a number of Arab countries' utility sectors to make electricity provision in the region fit for its essential role in powering sustainable development.

Access to CFTs lags behind progress made in the area of electrification, implying considerably more dedicated efforts to target CFTs are required than has been the case in the past. In countries with remaining access deficits, focused policy action, monitoring and enforcement are necessary to ensure progress. Generally, electrification receives more public attention than access to CFTs: policies need to recognize the importance of CFTs, even more so as CFT access rates lag significantly behind electrification. In conflict-affected countries and countries hosting large refugee populations, such as Lebanon and Jordan, many more people are affected by prohibitively high energy costs, leading to a reversion of past progress in accessing lower-quality fuels. Again, current data unlikely to capture these developments adequately. Failure to address CFT access leads to severe health and environmental implications which none of the countries with incomplete access to CFTs can afford. There is also significant scope to integrate electrification and CFT access with wider climate goals and policies.

Access to finance remains a critical enabler of universal access to CFTs and increasing access to electricity in deficit countries. Cooking stoves, fuel and the majority of stand-alone electricity generators including solar systems and solar water heaters, are bought on a cash basis. For many low-income households, the substantial initial investment in new technology remains a financial challenge, rendering access to CFTs and electricity solutions in the absence of available microfinance unaffordable.[43] Market mechanisms that increase the amount of microfinance available to these users would provide an important tool to help step up access by those households which are currently unable to afford better technologies. This includes finance for the initial stand-alone electricity system (e.g. solar panels and their installation); the initial cost of connecting to a local mini-grid; or the initial cost of a cleaner stove.

Studying energy access also highlights the desperate need for much better-quality data. While a global challenge, access to data is a particular challenge in the Arab region. Lack of actual data is a major constraining factor, which highlights the need for far more frequent, standardized household consumption surveys that generate regionally comparable data. Important current data gaps include standard consumption patterns and affordability, but also electricity service quality and gender-disaggregated access data. Survey data quality is often poor, with data being old, forcing conclusions to be made on results collected from a small number of households many years ago. This increases the challenge of informed decision-making and the design of solutions to people's needs tremendously. This is a call for far more policy engagement, including internal capacity-building, by governments across the Arab region to help and improve their own capabilities in addressing these challenges.

Improved access to information is also a fundamental importance to citizens and businesses, both parts of driving national solutions. The role of governments is critical in making available information, through upgraded technology quality controls and regulation, and the dissemination of dedicated information. Since lack of energy often translates into lack of access to the outside world, the role of governments in making information available is even more critical in deficit countries, in particular in the Arab LDCs. This includes information about technology solutions suitable to different user groups, from improved cooking stoves and better fuels to financing opportunities available to final users.

2. Energy Efficiency

SDG 7.3 tracks progress in the rate of improvement in energy efficiency. It is measured through energy intensity as an imperfect but workable proxy indicator, which is calculated as the amount of energy used per unit of GDP. SDG 7.3 targets a doubling of the world's rate of improvement in energy intensity by 2030, implying energy intensity should fall continuously. This chapter examines progress in reductions in energy intensity in the Arab region.

Main messages

- **Regional trend:** Arab region average energy intensity rates remain all but unchanged at 4.7 MJ/USD 2011 PPP continuing a long-term flat trend of autonomous and largely structural energy efficiency improvement since 1990. The Arab region has the second lowest energy intensity of the world's regions, largely a result of its fuel mix based on widespread efficient use of gas. The recent energy intensity trend for the region is a drop of –2 per cent compound average growth rate (CAGR) from 2014 to 2016. This is a necessary improvement over the medium-term 2010–2016 improvement rate of –0.6 per cent and an important reversal over the long term, an increase in regional energy intensity from 1990 to 2010.

- **2030 target:** At –2.0 per cent during the latest two-year period, and –0.6 per cent from 2010 to 2016, improvement in energy intensity across the region is still behind the world average energy intensity improvement rate of –2.3 per cent from 2010 to 2016. The region has yet to implement energy efficiency at sufficient scale and speed to meet SDG 7.3 target. Most countries in the Arab region still need to transpose energy efficiency ambitions and plans into largely implemented measures and measurable energy efficiency progress. Regional energy intensity progress needs to accelerate from a passive trend to a more active policy-driven investment in energy efficiency. Some substantive new policies have emerged, offering evidence that well-designed, implemented policies achieve results. There are country experiences in the region that are regional exemplars, offering a learning process that can be copied in how energy efficiency is a strategic investment in a country's economic development. The rewards occur across all SDGs as SDG 7.3 creates multiple benefits in improved well-being and productivity, as well as reduced global and local emissions.

- **Subregional trends.** The Maghreb without Libya, the Mashreq, and Arab LDCs have seen a long-term trend in falling energy intensity since the 1990s and lay around the 4 MJ/USD 2011 PPP range by 2016. Conflict and instability have significantly affected concerned countries' energy intensity rates over the tracking period and before, in particular Iraq, Libya, the State of Palestine and the Syrian Arab Republic. The GCC exhibits different dynamics than the rest;

overall energy intensity in the GCC has been rising since the 1990s, albeit with a gradual decline in more recent years, to around 6 MJ/USD 2011 PPP in 2016. Bahrain and Qatar's energy intensity is far above the rest of the GCC, though with a downward trend.

- **Conflict and energy intensity.** Conflict-affected countries' energy intensity levels are substantially higher than those of neighbouring countries and fluctuate considerably over time. Iraq, Libya, the State of Palestine and the Syrian Arab Republic experienced significant disturbances to their economic activities during the period under study, due to the ongoing geopolitical conflict in the region. Conflict-induced effects on energy intensity include damage to key energy infrastructure, including power plants, transmission and distribution (T&D) infrastructure, dams and conflict-driven constraints to operation and maintenance. This also impacts the region, with neighbouring Lebanon and Jordan each hosting high numbers of refugees.
- **Sectoral trends.** Agriculture and services have seen the deepest fall in energy intensity in the Arab region since 2010. Regional averages of the sectoral energy intensities based on sectoral final energy consumption improved by –8.2 per cent CAGR and –3.9 per cent CAGR between 2010 and 2016 for the agricultural and service sectors respectively. The industrial sector's energy intensity increased slightly (+0.2 per cent CAGR) and the residential sector intensity also increased (+1.7 per cent). These trends have been observed across all Arab countries, except for Egypt, Iraq, Morocco and Jordan, which also had their industrial sector energy intensity improve. The same trend is confirmed over the tracking period. The change in sectoral energy intensity and total primary energy intensity (PEI) over the two bienniums seems to indicate that most of the improvement in energy intensity is probably due to changes in the economy structure, moving towards more energy productive activities.

Are we on track?

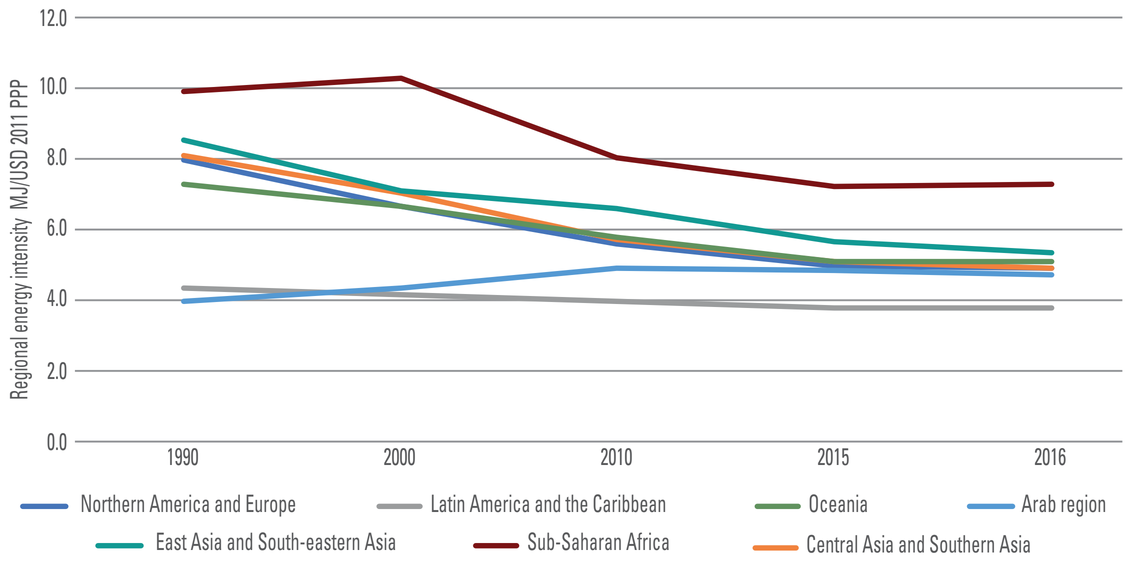
Energy and energy intensity trends: the Arab region and the rest of the world

The Arab region is not on track with global energy efficiency targets. Regional energy intensity rose during the 1990s—contrary to most other regions of the world —and has only started to decline slowly since the beginning of the 2010s. In 2016, aggregate regional energy intensity stood at around 4.7 MJ/USD 2011 PPP, a decline of around 3 per cent over the six-year period. While the Arab region has the second lowest regional energy intensity rate in global comparison, this decline is not enough to help the region maximize the productive use of its energy resources.

Considerable industrialization and economic and social development have occurred in many Arab countries over the period since 1990. This reflects, among other things, a history of utilizing the regions low-cost oil and gas resources as countries developed from the 1950s with state-of-the-art efficient power-generation technologies. Unlike many of the world's regions, historically inefficient coal power and industrial systems have been avoided. Much of the regions' development was coincident with the emergence of increasingly efficient gas power-generation plants, expansion of plentiful, low-cost, local oil and associated gas resources, and improving energy efficiency of end-use appliances and equipment since the 1990s.

There has been modest, positive progress over the tracking period.[1] The recent intensity trend for the region is a drop of –2.2 per cent CAGR from 2014 to 2016. This is in contrast to an increase of 0.8 per cent CAGR from 2012 to 2014. The trend from 2010 to 2016 is –0.6 per cent CAGR, an important reversal over the 1.1 per cent CAGR increase in energy intensity from 1990 to 2010. Moreover, the Arab region energy intensity progress rate has improved over the past four years. Changes during 2014–2016 at country level show new progress, with some countries' results reflecting achievements in previous energy

Figure 17. World regional energy intensity trends, 1990–2016



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

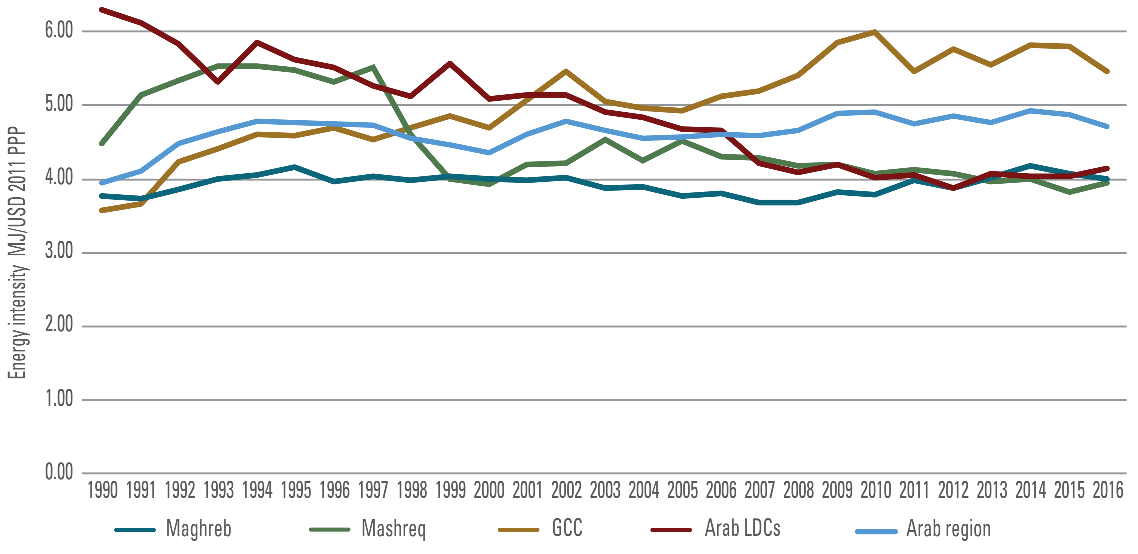
efficiency plans, scaling up policies and changing their energy intensity. These are explored later in this chapter.

Individual country progress varies considerably across the Arab region. Half the Arab region countries are reducing their energy intensity while energy demand and output continue to grow. Some countries have made significant advances in implementing new efficiency policies and programmes and are able to report developed trends of reducing energy intensity in the 2014–2016 period. In many Arab countries energy demand continues to grow with population and development drivers. Europe, North America and Asia have improved their energy intensity by more than 30 per cent in the past 25 years but started from a higher base of energy intensity.

Geopolitical conflict and instability profoundly impacted energy productivity in affected countries. Conflict and instability in Libya, the State of Palestine, the Syrian Arab Republic and Yemen are linked to changing, in some cases, highly fluctuating energy intensity rates. The important increase in energy intensity in the Syrian Arab Republic of 14.9 per cent CAGR during 2014–2016 reflects abnormal disruptions in energy-activity relationships. Developments in energy intensity rates in more recent years in Jordan and Lebanon are also linked to neighbouring unrest, as increasing demand for housing, energy services and other goods in the economy affects their energy–activity relationships. It is difficult, under these circumstances, for the energy intensity indicator to reflect progress in energy efficiency.

Further efforts are required to meet target rates. Improvements in global energy intensity since 2010 are lagging behind the needed energy efficiency growth rate for SDG 7.3 of –2.6 per cent (a doubling of the historical 1.3 per cent rate). As a result, progress to 2030 targets now needs to improve to an average –2.7 per cent energy intensity improvement globally to meet the SDG 7.3 energy efficiency target and the Arab region needs to reach a regional, aggregate, average annual improvement rate of –3.4 per cent CAGR in order to meet the global 2030 target.

Figure 18. Arab subregion energy intensity trends from 1990



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

Arab subregions

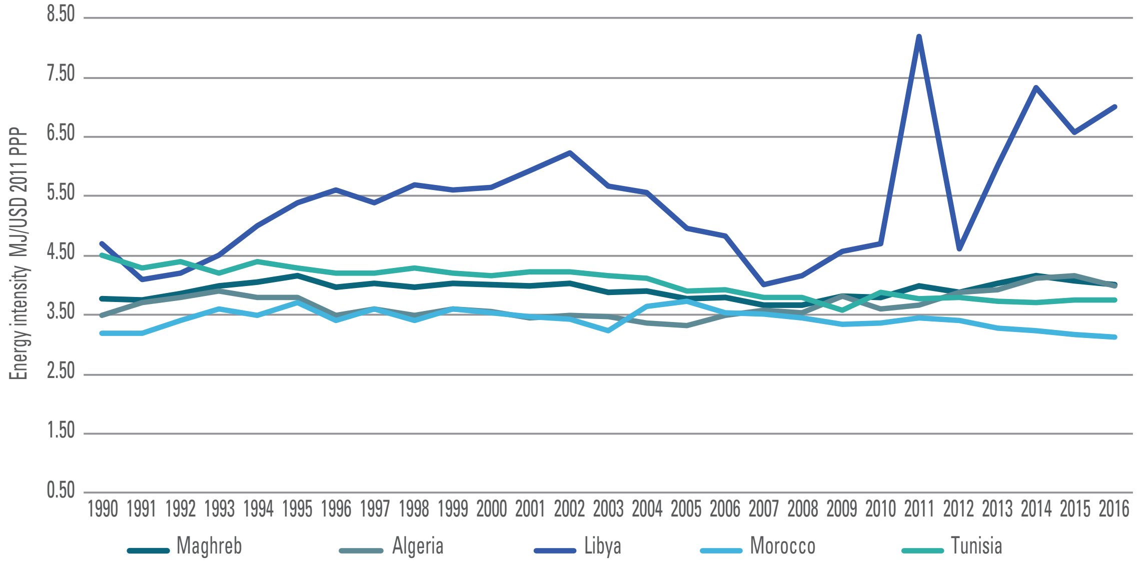
Energy intensity trends differ between subregions and countries. Within the Arab region there is a clear distinction between the GCC countries where the aggregate average of the energy intensity peaked at 6.0 MJ/USD 2011 PPP in 2010 and moved to 5.5 MJ/USD 2011 PPP over the past six years, and the other three regions which have converged over the past 10 years to 3.9–4.1 MJ/USD 2011 PPP, below the Arab region average of 4.7 MJ/USD 2011 PPP . The direction of change in the rate of energy intensity also differs across subregions, though these trends tend to be associated with the performance of one or two dominant economies. The subregional picture is hence very complex; energy intensity trends are much more an issue associated with the country level rather than subregional trends.

The Maghreb

The Maghreb as a subregional aggregate has seen slightly rising rates of energy intensity since the 1990s, with a slight decline over the tracking period. Less extensive oil and gas resources have enabled exports and supported increasingly urbanized economies. Industrial productivity has increased and a shift to service-structure economies has been observed, albeit with a remaining important share of agriculture in Morocco and Tunisia in particular. Different political histories and the processes of achieving independence from colonial pasts have shaped differing socioeconomic development paths and political situations in Algeria, Libya, Morocco and Tunisia. Libya has experienced substantial disturbances to its economy due to ongoing internal conflict since 2012.

Without Libya, the Maghreb sees an overall long-term trend in slowly declining rates in energy intensity, with the partial exception of Algeria. Morocco continued its long-term trend of gradual energy intensity improvement in 2014–2016, reflecting a steady trend of increasing GDP at a higher rate than the rate of increase in primary energy supply. Algeria has also been experiencing similar trends, but only over the most recent tracking period. The rate of improvement of energy intensity in Tunisia seems to have been affected by the slow pace of the

Figure 19. Energy intensity trends in Maghreb countries



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

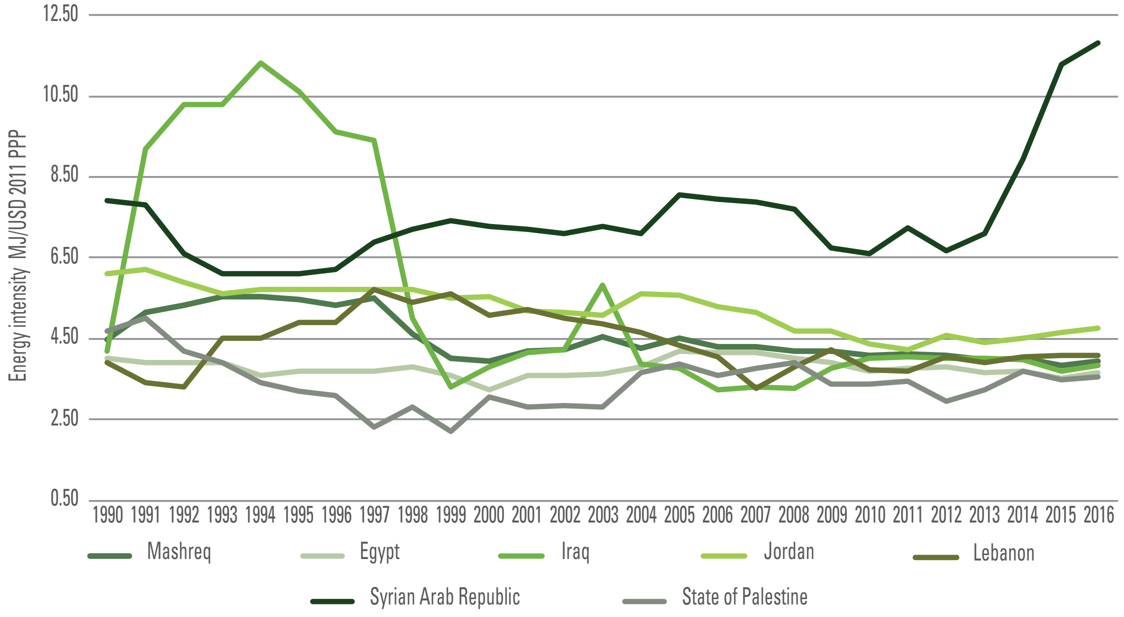
economy during the last few years. Libya's energy use and intensity has fluctuated widely since the revolution in 2011, when it peaked at 8.2 MJ/USD 2011 PPP and since 2014 has been higher than the country's historical peak, prior to 2011, of 6.2 MJ/USD 2011 PPP observed in 2002. This is probably due to the crumbling of its economy with a decline in GDP of –11 per cent CAGR between 2010 and 2016.

The Mashreq

The Mashreq has seen a slight decline in energy intensity rates, albeit with individual country exceptions. With the exception of Jordan and the Syrian Arab Republic, these countries have maintained an energy intensity level around 4 MJ/USD 2011 PPP, with Egypt and the State of Palestine reaching levels around 3.5 MJ/USD 2011 PPP during the last three years. Mashreq countries have less extensive oil and gas resources than their GCC neighbours, some exports and support increasingly large urban populations with developing industrial productivity. Iraq, the State of Palestine and the Syrian Arab Republic experienced significant disturbances to their economic activities during the period under study, due to the ongoing geopolitical conflict in this region. These conflicts impacted heavily on neighbouring countries in this subregion.

Conflict and instability have had a strong influence on energy intensity in Iraq and the Syrian Arab Republic, as well as some of their neighbours. During the 2014–2016 biennium, intensity in the Syrian Arab Republic with energy use halving from 907 PJ in 2010 to 416 PJ in 2015 and energy intensity from 6.6 MJ/USD 2011 PPP to 11.8 MJ/USD 2011 PPP while GDP dropped from 137.6 billion PPP to 35.2 billion USD 2011 PPP. The Syrian Arab Republic's economic base has collapsed and access to energy services is now disrupted. All the country's hydroelectric dams and six of 18 power plants remain operational, while four more power plants are partially damaged, and one has been destroyed. Fuel shortages and conflict-driven constraints to operation and maintenance have led to a sharp reduction in public power supply. Power generation declined to 16,208 GWh in 2015, compared with 43,164 GWh in 2010: a drop of

Figure 20. Energy intensity in Mashreq countries



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

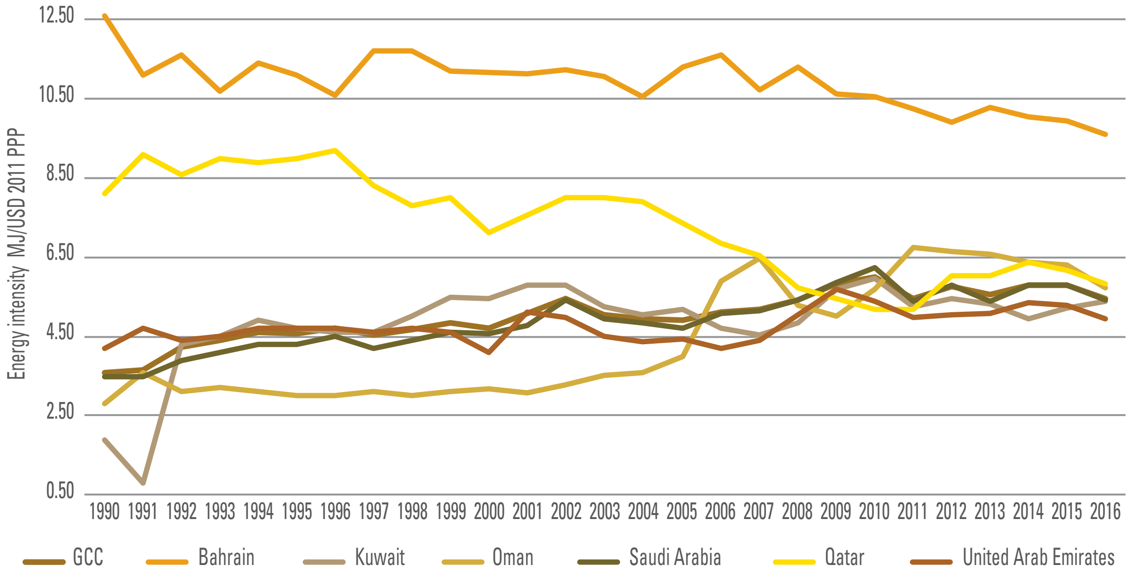
62.5 percent. Much of this decline appears to be due to fuel shortages, as available generation capacity declined by about 30 percent in the same period. [2] This also impacts the region, with neighbouring Lebanon and Jordan each hosting large numbers of refugees. Energy intensity improvements have stalled at 4.1 MJ/USD 2011 PPP in Lebanon since 2011; in Jordan, there was an upturn from 4.5 MJ/USD 2011 PPP in 2014 to 4.7MJ/USD 2011 PPP in 2016.

Gulf Cooperation Council

Overall energy intensity in the GCC has been rising since the 1990s, albeit with a gradual decline in more recent years. Individual countries have driven the regional trend, with Kuwait, Oman, Saudi Arabia and United Arab Emirates undergoing long-term growth in their energy intensity rates since the 1990s, although from lower staring points. Bahrain and Qatar have seen a long-term trend in declining energy intensity rates, while at the same time being some of the region's—and the world's most energy-intensive economies. GCC economies are characterized by their carbon-intensive extractive industries, often with global competitiveness and global export of indigenous oil and gas products, and services. Most have developed downstream value-add in derived petroleum products and metal processing. High levels of terrestrial water scarcity on the Arabian Peninsula have been driving significant investment in high-efficiency integrated power water systems.

Bahrain, Oman, Saudi Arabia and United Arab Emirates observed in 2016 their lowest energy intensity since 2010. In 2016, Bahrain had an energy intensity of 9.6 MJ/USD 2011 PPP —the highest level in the GCC subregion. Bahrain, Saudi Arabia and the United Arab Emirates had similar trends during the last six years with a decrease of energy intensity during the 2014–2016 biennium (–2.4 per cent, –3.5 per cent and –3.8 per cent CAGR, respectively). The three countries had an increase of energy intensity during the previous 2012–2014 biennium (+0.8 per cent, +0.3 per cent and +2.9 per cent CAGR, respectively), however. These rates followed yet another decrease of energy intensity for the

Figure 21. Energy intensity in Gulf Cooperation Council countries



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

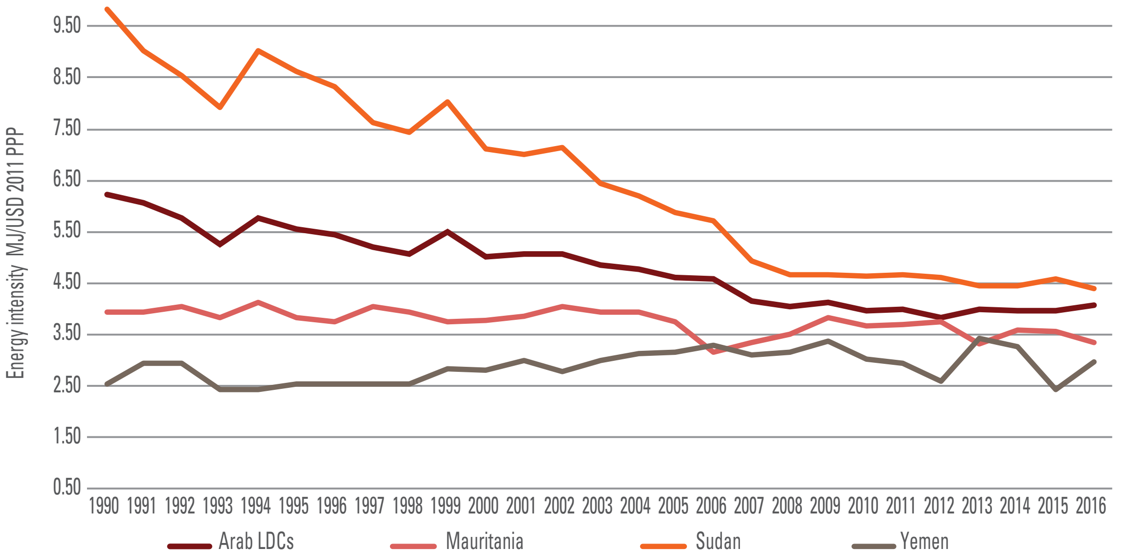
three countries during the 2010–2012 biennium (–3.1 per cent, –3.7 per cent and –3.2 per cent CAGR, respectively). Kuwait is the only country in the subregion that observed an increase of energy intensity during the 2014–2016 biennium (+4.4 per cent CAGR) after observing a decrease of energy intensity during the two consecutive bienniums of 2010–2012 and 2012–2014 (–4.4 per cent and –4.8 per cent CAGR, respectively).

GCC economies have been engaging critically in energy efficiency in recent years. During the 2014–2016 period Qatar, Saudi Arabia and the United Arab Emirates engaged in energy efficiency (EE) programmes, including substantial new initiatives (labelling and minimum energy performance standards (MEPS), EE financing programmes, etc.). In January 2014 the Saudi government confiscated 40,000 non-compliant air conditioners[3]. Moreover, since 2014, the United Arab Emirates Etihad energy service company (ESCO) launched energy efficiency projects worth 200 million dirham (AED) in around 2,500 buildings EE retrofit programme (over AED 180 million invested in 2016)[4] The per capita consumption of electric power in Qatar was 15,307 kWh per year in 2014. This consumption was reduced by 18 per cent as a result of the "Tarsheed" rationalization programme period (2012–2016)[5].

Arab Least Developed Countries

Arab LDCs have converged at energy intensities of around 4 MJ/USD 2011 PPP. With Mauritania and the Sudan being largely agrarian economies, industrial activity serves domestic or regional markets but is limited in exports. Both the Sudan and Yemen struggle with geopolitical conflict and all three countries face numerous constraints in energy access and services—a key limitation to development and increasingly linked to provision of safe water and food. Yemen was increasingly disrupted by its civil war during 2014–2016, with energy intensity increasing initially to 3.5 MJ/USD 2011 PPP as economic productivity fell, and then dropping to an abnormally low 2.4MJ/USD 2011 PPP as GDP fell by –35.7 per cent CAGR between 2014 and 2016 (oil and gas exports dropped from 480 PJ in 2014, to 18 PJ in 2015 and ceased in 2016), while primary energy supply declined by –38.7 per cent between 2014 and 2016. Energy intensity can be improved if activity growth equals

Figure 22. Energy intensity trends in Arab LDC



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).

or exceeds the rate of growth in energy demand, but these countries need to both increase their access to energy and efficient energy services as well as grow their economic activity and well-being. With real energy constraints, energy efficiency integrated with distributed energy systems offer development potential as well as improved access. The Sudan's energy intensity has levelled off at 4.5 MJ/USD 2011 PPP since 2008, Mauritania's reduced from 3.7 MJ/USD 2011 PPP in 2010 to 3.4 MJ/USD 2011 PPP in 2016.

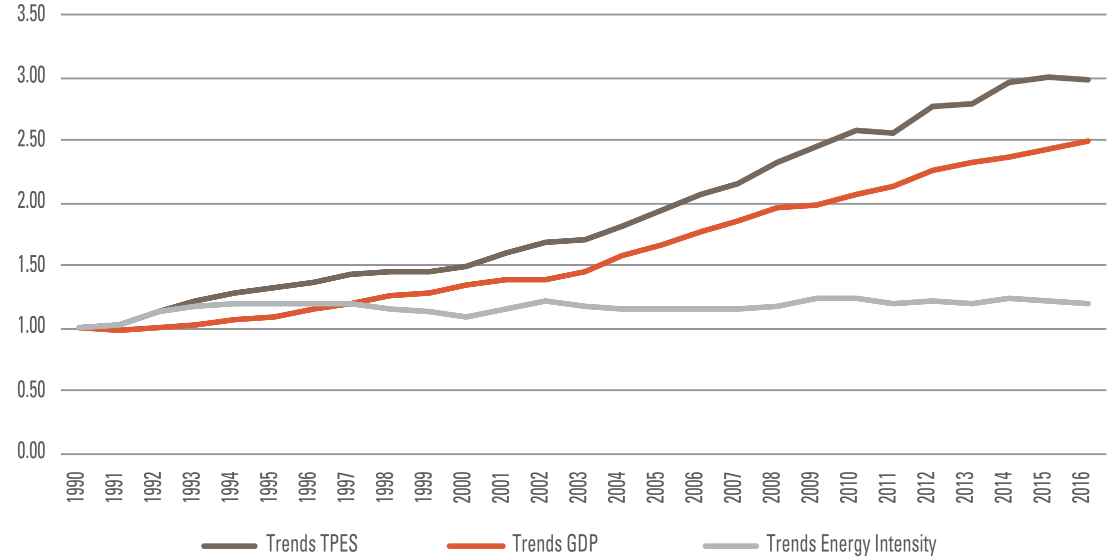
What has caused regional energy intensity to decline?

Trends in regional energy intensity cannot be reduced to one single causal factor. At an aggregate level, energy intensity offers little insight into the underlying energy efficiency, while changes in end-use efficiency need to be disaggregated from activity, structural and other changes. Figure 23 shows regional aggregate GDP and total primary energy supply (TPES) have grown at similar rates. The levelling off of TPES growth from 2014 could be a tentative shift towards improving energy productivity. Below, aspects of energy intensity changes over the past period from 2010 will be presented to develop better insight into short-term changes.

GCC countries shift structure and advance energy efficiency

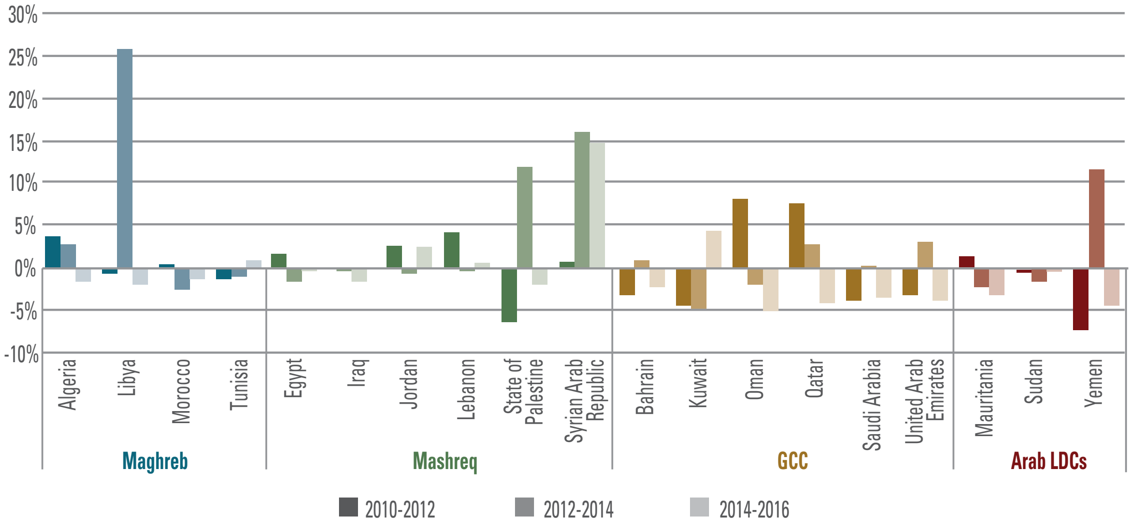
Structural shifts in GCC energy markets have a profound impact on regional energy intensity due to the size and relative weight of their energy markets. Figure 24 tracks the biennial rates of change in energy intensity from 2010. This medium-term trend is important as it tracks how the range of structural changes and energy efficiency policies are playing out in influencing country energy intensity in the short-term. With the exception of Kuwait, all GCC countries have reduced their energy intensity during the 2014–2016 biennium, with Oman having reduced its energy intensity during the previous 2012–2014 biennium as well. Most GCC countries had engaged in energy efficiency policies in preceding years but it is difficult to attribute the drop in energy intensity to these policies. Some important shifts are taking place in the economic structure towards less energy intensive activities, however. For example, 43 per cent of GCC GDP in Bahrain was in services (up 30 per cent from

Figure 23. Trends in TPES, GDP and energy intensity – Arab countries



Source: ESCWA calculation based on the International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019)

Figure 24. Biennial changes in country energy intensity

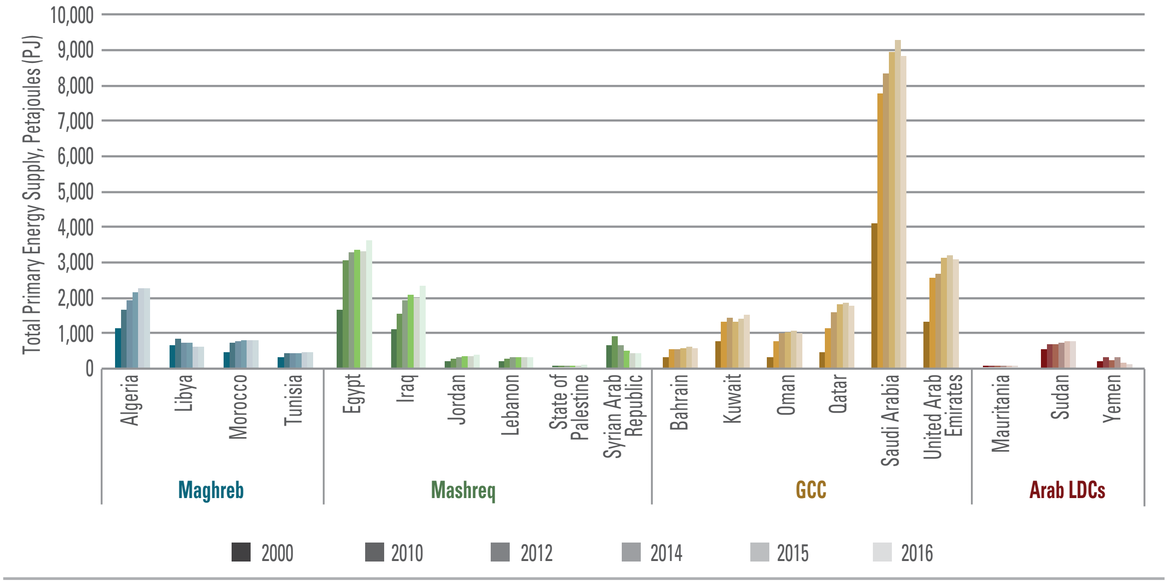


Source: ESCWA calculation based on the International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019)

33 per cent in 2010), 43 per cent from Industry (down 20 per cent from 54 per cent in 2010). These substantial shifts in sectoral mix, along with autonomous energy efficiency improvement are important contributors to the improvement in energy intensity.

Most other Arab countries managed to maintain or lower the level of their energy intensity during the 2014–2016 biennium. Some have engaged in economic structural changes and many have developed, or are developing, EE policies and programmes. It is, however, important to also

Figure 25. Arab region countries: Total Primary Energy Supply (PJ)



Source: International Energy Agency, 2018 and United Nations Statistics, 2019.

examine the impact of other non-energy related factors on the evolution of energy intensity. For example, variation of local currency exchange rates on valuation of GDP have been significant in some countries. In turn, this alters the valuation of energy intensity. Between 1 January 2014 and 31 December 2016, the Algerian dinar was devaluated by more than 28 per cent, the Egyptian pound by more than 61 per cent and the Tunisian dinar by more than 29 per cent. Experiencing unrest, Libya, the Syrian Arab Republic, the Sudan, and Yemen struggled to maintain declining rates of change in energy intensity as economic activity and energy systems were disrupted. In 2012–2014, energy intensity in each of these countries changed from reducing energy intensity to abnormal growth in energy intensity (around +12–26 per cent) as economic activity was disrupted and fixed components of energy use in the economy persisted.

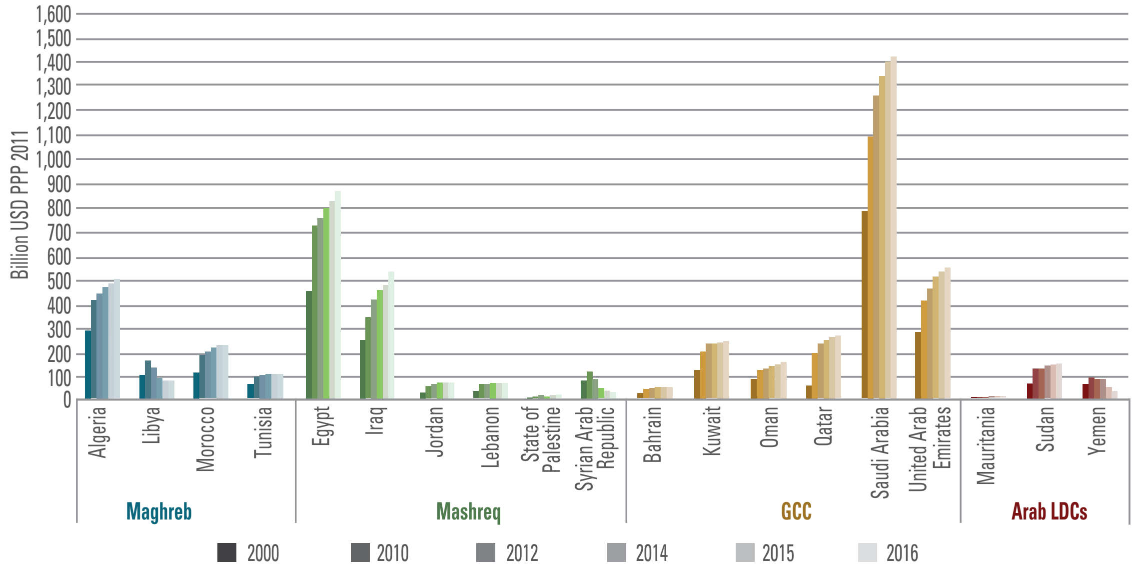
Some countries are reducing their historical energy growth trends

There are some signs that economic activity is starting to decouple from energy use. Few countries in the region have continued their general trend to increasing energy use as they develop. Primary energy growth in the industrialized GCC countries started to stall, or slightly reverse from 2014 as less energy intensive economic activities have been developed. This is probably due in part to the fall of global oil prices from a record annual average price in 2014 (Brent average annual prices: USD 98 in 2014, USD 53 in 2015, USD 45 in 2016), stimulating new economic and budget approaches in oil-exporting countries.

Improving value from economic activity

Changes in currency value, GDP earnings as well as in economic activities and their associated energy use and efficiency, alter energy intensity. Figure 26 highlights the scale of economic activity change in Arab region countries. Notably, Saudi Arabia and Qatar have dropped –1.4 per cent and –3 per cent respectively below their 2014 primary energy supply levels. Most countries held or grew their GDP between 2014 and 2016, after oil prices dropped in 2014. Oil-/gas-exporting countries (Algeria +7.2 per cent, Bahrain +6.2 per cent, Kuwait +4 per cent, Saudi Arabia +5.9 per cent, Oman +10 per cent, QATAR +5.9 per cent, United Arab Emirates +8 per cent) grew GDP despite

Figure 26. Economic activity trends in the Arab region (GDP USD 2011 PPP), 2000 - 2016



Source: ESCWA calculation based on the International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019)

falling oil prices, often drawing on sovereign reserves. Libya, the Syrian Arab Republic and Yemen all showed a decline in activity associated with conflict in these countries.

The progress for energy efficiency is often tentative. Arab countries that are starting to build implementation substance to their energy efficiency policies will experience a lag as policies take some time to influence investment, operations and behaviour. Robust programmes of policies tend to embed consistent changes trends in energy use and increased value. Whether this change can be sustained remains to be seen, but countries with effective energy efficiency policies do tend to generate consistent energy intensity improvement trends that flow on to stall energy use growth.

Investment drivers of energy efficiency

Arab countries lag behind in dedicated investment in energy efficiency. A number of methods have been used to estimate energy efficient investment and are reported in the IEA Energy Efficiency Market Report 2014.[6] Using the simplest approach—an estimate based on an assumed percentage of Gross Fixed Capital Formation (GFCF) that goes to energy efficiency improvements in new assets. Using the IEA approach mentioned above, the Arab region's nominal share of global energy efficiency investment estimated to be USD 17 billion, implying that only 2.7 per cent of a regional USD 623billion GFCF.[7] This is below observed energy efficiency investment rate levels around 5 per cent to 15 per cent identified in countries with developed energy efficiency policies in the IEA Energy Efficiency Market Report 2015. These are naïve estimates, but they highlight a need for governments to consider that effective policies will increase the percentage of existing GFCF that goes to more energy efficient plant and are not necessarily an increase in costs or investment requirements.

Progress has been registered in some countries that have elevated energy efficiency into concrete national policy action areas. Government-sponsored super ESCOs, such as the United Arab Emirates Etihad and Saudi Arabia's Tarshid initiatives, are emerging as powerful financing options (Box 5). The Super ESCO approach to advancing energy efficiency has many advantages for the region including[8]:

- Barriers and challenges unique to the region can be addressed to create substantial change.
- Policy and institutional frameworks can be readily implemented and accelerated.
- Super ESCOs are a low-risk efficient vehicle for channelling public funds, donor or development bank funds for energy efficiency and renewable demand-side solutions.
- Implementation offers citizens, business and governments economic returns on investment from energy efficiency and renewable energy to reduce government budgets, minimize new supply infrastructure and repay loans while creating jobs and reducing emissions.
- Local small and medium-sized enterprises (SMEs) are enabled as ESCOs develop capacities and create market opportunities.
- Monitoring intervention quality assurance raises investor and stakeholder confidence.
- Governments can catalyse significant return on investment from energy efficiency though Super ESCOs; in the case of Etihad, the present value of outcomes is 1.7 times the investment.

Box 5. Super ESCOs in the Arab region

By 2017, Etihad ESCO had reduced electricity demand by 170 GWh and water by 470 million gallons. The 2017 Annual Report of the Dubai Regulatory and Supervisory Bureau (RSB) for electricity and water highlighted investments in energy efficiency projects of AED 250 million in 2017, an increase of one-third compared to 2016. These projects are expected to achieve 21 per cent reductions in electricity and 31 per cent in water. Etihad launched, since 2014, energy efficiency projects worth AED 200 million in building retrofits.

With a target of 30,000 buildings by 2030 (Dubai's demand-side management (DSM) strategy is for a 30 per cent reduction in energy use by 2030), Etihad is developing sustainable design and procurement capabilities. The cumulative cost of these strategic projects will be around AED 30 billion, while the estimated value of savings is AED 82 billion, giving the Demand Side Management plan a positive net economic impact with a Net Present Value of AED 52 billion.

Saudi Arabia's Tarshid Super ESCO has a capital of USD 507 million to fund and manage energy efficiency and renewable energy retrofits of public buildings. A royal decree requires government entities to contract Tarshid to improve energy use. It will leverage energy efficiency in the kingdom from the public sector with its 110,000 government buildings, 35,000 schools, 100,000 mosques and 2,500 medical centres with projects estimated to be worth USD 800 million (3 billion Saudi riyals (SAR)) annually. Initial projects include:

- Phase 2 of the streetlight retrofit programme replacing 216,700 streetlights with light-emitting diodes (LED) in Dammam, Al-Khobar, Al-Dhahran, Al-Ahsa and Sakaka to reduce energy consumption by 77 per cent, or 2,41 GWh annually
- Launching the third phase of the streetlights retrofit programme in Jeddah, Al-Qassim, Riyadh, Al-Ahsa and some of Al-Jouf region governorates. The number of total retrofitted streetlights will then reach 0.5 million—one quarter of the nation's 2 million streetlights, when completed.

The Saudi Government worked with the World Bank to develop and realize Tarshid.

Source: ESCWA, 2019c.

[a] https://www.etihadesco.ae/wp-content/uploads/2018/10/CEO_Message.pdf

[b] https://www.tarshid.com.sa Reuters, Riyadh. Wednesday, 18 October 2017 in http://english.alarabiya.net/en/business/energy/2017/10/18/Saudi-s-PIF-sets-up-energy-service-firm-Super-Esco.html

Energy price reform that has been progressing in the Arab region is likely to play an important enabling role for more energy efficiency in the future. At the time of writing, energy subsidies remain a feature in many Arab energy markets for different user groups, although their size has been falling along with reform progress in some countries, coupled to fluctuating shadow prices on international markets. The International Monetary Fund (IMF) estimated USD 250 billion of energy subsidies in 2015[9], at an average rate of 8.3 per cent of GDP, an average subsidy value of USD 715 per capita. Recent changes in end-user fuel-price subsidies and structure of electricity prices in Arab countries are reported (ESCWA, 2019b). Lack of cost-reflective energy prices is a major disincentive to energy efficiency and distributed renewables (end-user applications, small-scale, grid-connected power stations). Box 6 highlights an example from Saudi Arabia showing that prices have a profound effect on uptake of efficiency and at a scale where they affect policy outcomes.

Table 1. Changes to subsidies during the period 2014–2017

Country	Actions
Bahrain	Raises industrial natural gas prices, annual price increase plan until 2021.
Egypt	Five-year plan to phase out fuel and electricity subsidies by 2019.
Jordan	Increases domestic fuel prices consecutively by 3.11 per cent, 4 per cent, 6 per cent.
Kuwait	Doubles diesel prices.
Morocco	Eliminates subsidies for gasoline and industrial fuels.
Oman	Increases natural gas prices.
Qatar	Increases diesel prices – "floats" domestic fuel prices to international prices.Increases electricity tariffs.
Saudi Arabia	Five-year programme to gradually increase water, electricity, gas and petroleum prices.
Tunisia	Halves energy subsidies to some industries, eliminates some subsidies to industry. Increases electricity tariffs; reform programme to eliminate electricity subsidies by 2021.
United Arab Emirates	Abu Dhabi increases water and electricity prices. United Arab Emirates links domestic transport fuel prices to international market prices.

Source: ESCWA, 2019b.

Box 6. Price elasticity for fuel economy and fuel price changes

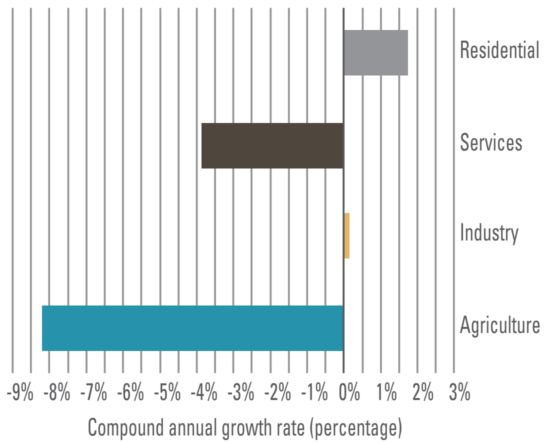
Price elasticity of fuel economy for new vehicles has been decreasing in Saudi Arabia over recent years, but it is still more elastic than the new vehicle market in the United States. The increase in domestic gasoline prices in Saudi Arabia between 2014 and 2016 accounted for 42 per cent of the increase in estimated new vehicle fleet fuel economy over that period. The remainder of the increase could be attributable to changes in product offerings and consumer preferences. This was perhaps driven by more cautionary spending, given the conservative outlook for Saudi Arabia's economy in that period due to lower international crude oil prices. Estimated elasticities—and thus policy sensitivities—vary by income and household size. Thus, a revenue-neutral 'feebate' policy—involving taxes on fuel-inefficient vehicles and rebates for fuel-efficient vehicles—could be more progressive than another gasoline price increase.

Source: Tamara and Rubal Dua, 2019.

Agriculture and services see the largest fall in energy intensity since 2010

Agriculture and services have seen the deepest fall in energy intensity in the Arab region since 2010. As can be seen in Figure 27, the regional averages of the sectoral energy intensities, based on sectoral final energy consumption, improved between 2010 and 2016 for the agricultural and services sectors: –8.2 per cent CAGR and –3.9 per cent CAGR, respectively. The industrial sector's energy intensity increased slightly (+0.2 per cent CAGR) and the residential sector intensity also increased (+1.7 per cent). These trends have been observed across all Arab countries, except for Egypt, Iraq, Morocco and Jordan, where industrial sector energy intensity also improved.

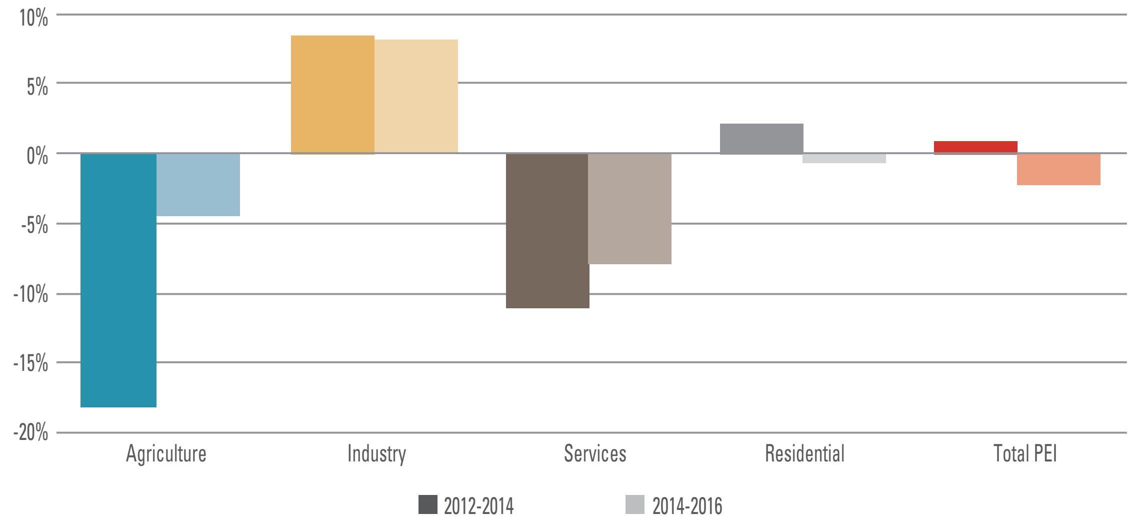
Figure 27. Growth rate (percentage) of energy intensity by sector in the Arab region, 2010– 2016



Sources: ESCWA calculation based on the International Energy Agency, 2018 and World Bank, 2019b. (accessed April 2019)

The same trend is confirmed over the tracking period. Figure 28 shows the change in energy intensity for the period 2012–2014 and 2014–2016 for agriculture, industry, service and residential sectors, as well as the total primary energy intensity. Again, the agricultural and services sectors are showing improvement in their energy intensity for both bienniums. The residential sector shows an improvement only in the latest biennium and the industrial sector does not show any improvement for the two periods.
The total primary energy intensity shows a net improvement in the second biennium. The change in sectoral energy intensity and total primary energy intensity over the two bienniums seems to indicate that most of the improvement in energy intensity is probably due to the changes in the economy structure, moving towards more energy productive activities.

Figure 28. Change in sectoral energy intensity in the Arab region (per cent), 2012–2016



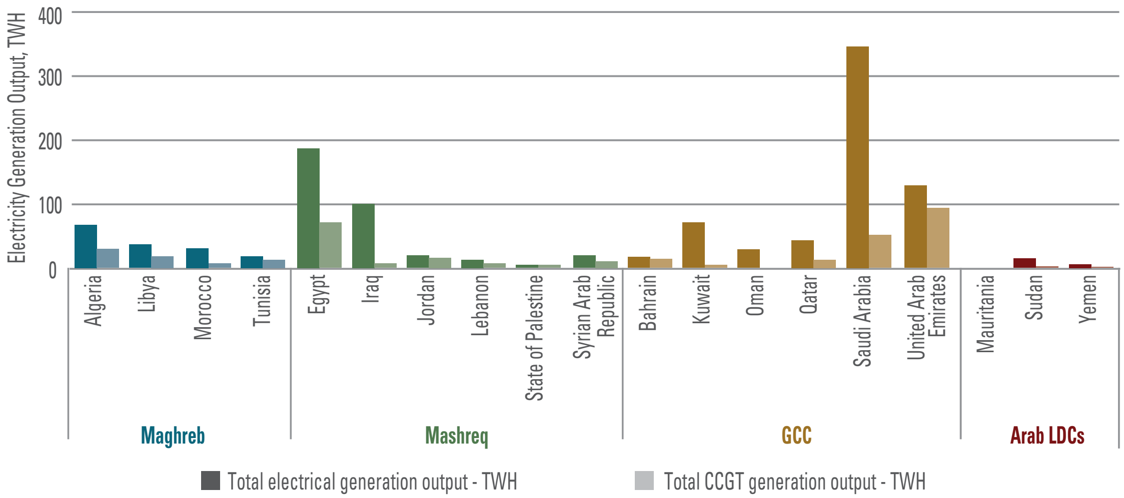
Sources: ESCWA calculation based on the International Energy Agency, 2018 and Arab Monetary Fund, 2019 (accessed 24 July 2019)

Electricity and water

Energy efficiency in the power and water sectors differ across the region. In countries without water security challenges, the baseload power plants tend to be large gas-fired combined cycle plants, with a range of older smaller single-cycle gas turbines often operating to match peaks in demand. Algeria for example has 1.8 GW of pre-1990 gas-fired steam turbines, 1.7 GW of pre-2010 single-cycle gas turbines, 1.6 GW of pre-2013 combined cycle gas turbines (CCGTs), 1.4 GW of single cycle gas turbines from 2014 to 2018. In 2017/2018, 5 GW of CCGTs were added and will displace older plant down the system operating merit order. With baseload generation dominated by the new CCGTs, system operational efficiencies increase. In high-income Arab countries, particularly where integrated water and power production plants are installed, power sector average efficiency is comparable to that in Europe (where district heating systems use waste heat from power plants) despite a range of environmental, demand and operating differences. Figure 29 shows the total generation in 2016 and the output from high efficiency combined CCGTs. This reflects both the plant design and operating efficiency and the degree to which the high efficiency plants are utilized over a year.[10] Reported average generation operating efficiencies for countries include: Algeria 42 per cent, Iraq 30 per cent, Jordan 42 per cent, Kuwait 35 per cent, Libya 37 per cent, Saudi Arabia 38 per cent, the Sudan 21 per cent, Tunisa 36 per cent.[11] Global average efficiency of fossil-fuelled power plants is now nearly 40 per cent as higher efficiency gas and coal plants are adopted in China and India, where electricity demand is growing.

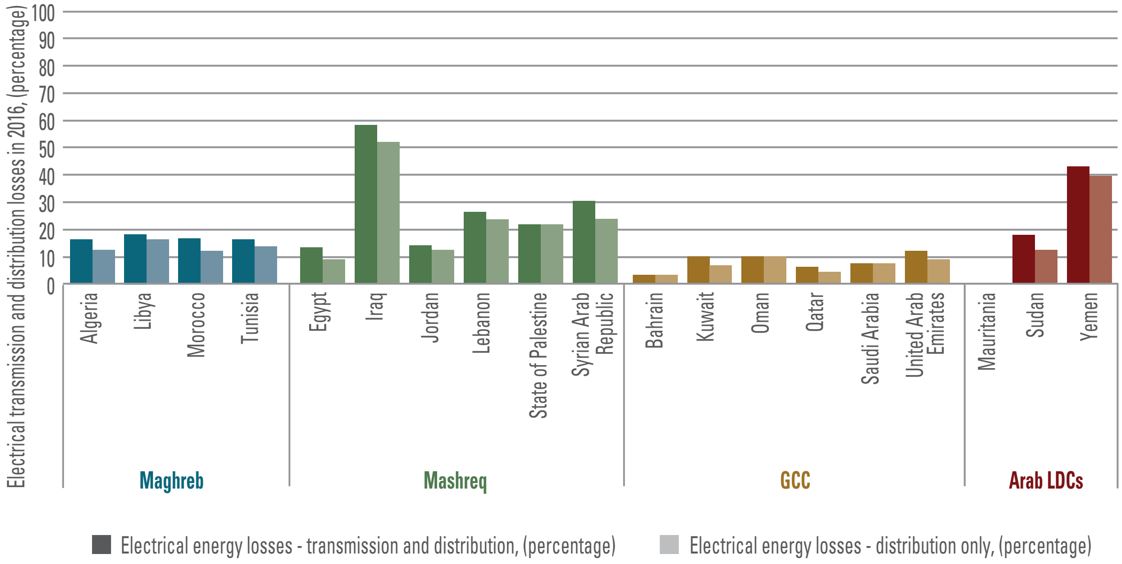
Some parts of the region incur high transmission and distribution (T&D) losses. In 2016, the total T&D losses ranged from 3.4 per cent to 58.2 per cent (Figure 30). Average transmission losses were 2.9 per cent, ranging from 1.8 per cent to 6.5 per cent and distribution losses ranged from 3.4 per cent –52 per cent, representing up to more than 90 per cent of the total T&D losses[12] .While a net improvement between 2014 and 2016 can be observed in most countries, remaining losses are a draining factor for already overstretched electricity sectors in some countries. Distribution losses include technical and non-technical losses, such as unauthorized connections to the electrical grid and consumption that was not billed or not paid for. Such non-technical losses are the main part of distribution losses when these are abnormally high (above typical values in the region), such as the ones reported for Iraq (58 per cent), Yemen (44 per cent), the Syrian Arab Republic (30 per cent) and even Lebanon (26.5 per cent).

Figure 29. Total generated output and CCGT output in Arab power sectors in 2016 (TWh)



Sources: Arab Union of Electricity, 2016b.

Figure 30. Country total transmission & distribution losses in the Arab region (per cent), 2016



Sources: Arab Union of Electricity, 2016b.

Transport

There is significant scope to improve the efficiency of energy used in transport in the Arab region. Arab region transport fuel consumption is 39 per cent of total energy use, more than 18 per cent higher than the global average.[13] Reasons include existing transport network quality and quantity, including the availability of public transport options, average travel distances, abundance of low-cost fuels, transport cost reflectivity, climatic factors and sociocultural preference, which, when combined, create conditions for ongoing growth in transport energy demand and high-carbon travel. In 2016, the transport sector used 5.92 exajoules (EJ) or 32.2 per cent of the region's final energy consumption. Saudi Arabia (1,918 petajoules (PJ)), Egypt (783 PJ), Algeria (634 PJ) and the United Arab Emirates (490 PJ) are the largest transport-energy users in the region.

Significant gaps in data limit our understanding of transport-sector energy dynamics in the Arab region. Arab countries are poorly represented in transport statistics. Data limitations include vehicle imports, usage patterns and vehicle lifecycles, which render a thorough analysis of vehicle stock and effective policy-design requirements difficult. The Global Fuel Economy Initiative (GFEI) is working with Algeria, Morocco, Tunisia and Egypt to develop baseline transport information, with the following observations:

- **Algeria.** Based on the outcomes of a national workshop on "policy options to improve vehicle fuel efficiency held on 3-4 June 2015 in Algiers, average vehicle fuel efficiency in Algeria improved from 7.5l/100 km in 2005 to 7.0l/100 km in 2013, which may mostly be attributed to the government's policy to import new vehicles only.[14]

- **Egypt.** Car ownership has doubled over the past 10 years to 4.3 million cars and 46 cars per 1,000 inhabitants. Approximately 200,000 cars enter the fleet each year. In 2014, the fuel economy of new light-duty vehicles was just below 7 l/100 km, dropping from around 7.6 l/100 km in 2012.

- **Morocco.** Vehicle ownership is one-tenth that of developed countries, a low 0.07 vehicles per capita. Moreover, results from the 2011 transport energy consumption survey showed that the petrol passenger–vehicle segment of the Moroccan fleet consumed on average of 6.7 l/100 km, while diesel passenger vehicles' fuel consumption was slightly less at 6.2 l/100 km. This compares with an average across the passenger-vehicle fleet in Europe in 2015 of around 5.1 l/100 km However, it should be noted that the fuel economy of Morocco's new passenger–vehicle fleet is rated quite well against 2015 European benchmarks[15] and new light-duty vehicles averaged 5 l/100 km in 2013.[16]

- **Tunisia.** New vehicle average fuel economy was 5.4 l/100 km in 2012.

Despite the impression in car-dense cities such as Riyadh and Cairo, average vehicle ownership levels in the region are relatively low (Figure 31). Notwithstanding the density of vehicle use in some high-income Arab centres, there is scope for significant growth in vehicle ownership in the Arab region. Most citizens in the region have yet to achieve their mobility needs but, as figure 31 and 32 show, the region's population is quite urbanized and public transport and active travel modes offer substantial mobility in many cities. In contrast, car ownership rates in the GCC are comparably high.

Box 7. Energy efficiency focus on high-use oldest vehicles support achieving SDG gains in Cairo.

Greater Cairo is a conurbation of 23 million people at 12,000 person/km^2 in 2016. Expanding over the past 40 years, it is growing at over 2 per cent /year and is projected to double in population in another 40 years. Transport infrastructure has not kept up and mobility is challenged; average vehicle speeds are 11 km/h. In 2010, 90 per cent of[o] Egypt's cars had an engine size of less than 1.6 l and average fuel economy in 2005 was 13 per cent lower than the global average. Public transport vehicles are used much more than private vehicles and should be much more efficient than low-use vehicles. Some 225,000 buses emit more than 27 megatons of carbon dioxide ($MtCO_2$) and 17,000 t/yr of particulates per year.

Taxi upgrade. Greater Cairo's 163,000 taxis and minibuses make 83 per cent of journeys and had an average age of 32 years. Traffic Law No. 121 (2008), banned licences for transport vehicles older than 20 years to improve air quality, and reduce CO_2 and traffic accidents. The Egypt Vehicle Scrapping and Recycling Programme of Activities prevents banned taxis re-entering the fleet or being reused as private motor vehicles. Taxi owners can scrap their old vehicle for EGP 5,000 and obtain a new locally-assembled car without deposit. The owner pays fixed instalments for five years, with exemption from sales taxes. More than 50 per cent of the new taxis are natural gas vehicles.

A total of 45,000 new taxis have now replaced ageing taxis in Cairo alone. A 28 per cent improvement in fuel economy has been achieved from the scrapped vehicles: 13.16 l/100 km (gasoline) and 13.26 m^3/100 km compressed natural gas (CNG) and from the new vehicles: 9.39 l/100 km (gasoline) and 8.34 m^3/100 km CNG. Some 310,000 tCO_2 were avoided between 2013 and 2017, as well as carbon monoxide, nitrogen oxides and particulates. Traffic safety is improving across Egypt and the scheme creates local jobs and data on the vehicle stock.

Sources: [a] World Bank, 2018f.

[b] United Nations Framework Convention on Climate Change, 2010.

Figure 31. Vehicle ownership rates in the Arab region (vehicles/1,000 persons)

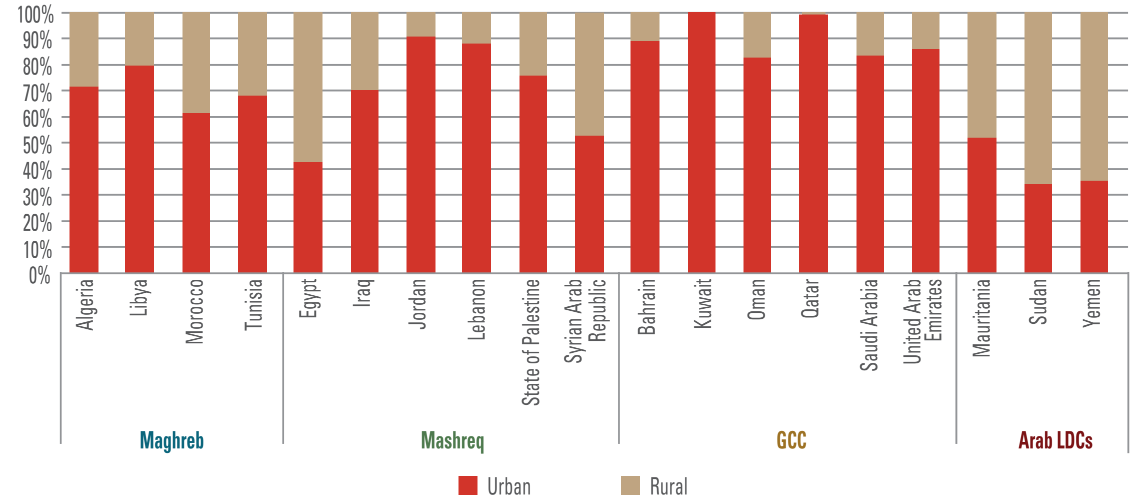
Countries	Car ownership/ 1,000 persons	Cars	Population	Year
Egypt	49	4,280,000	87,967,000	2014
Algeria	88	3,483,000	39,500,000	2014
Morocco	108	3,800,000	35,276,786	2017
Jordan	139	1,395,000	10,053,000	2017
Tunisia	143	1,600,000	11,154,370	2015
Iraq	149	5,660,885	37,880,000	2015
Iran	153	11,980,000	78,411,092	2014
Oman	228	984,886	4,316,539	2015
Lebanon	277	1,200,000	4,337,141	2010
Qatar	293	650,000	2,172,065	2014
United Arab Emirates	305	2,791,996	9,160,000	2015
Saudi Arabia	312	9,840,000	31,557,144	2015
Bahrain	360	536,716	1,492,584	2017
Kuwait	363	1,600,000	4,411,124	2016

Source: International Association of Public Transport, 2019.

Arab country vehicle fleets can include some very old vehicles with poor maintenance and energy performance. Many used vehicles are imported from Europe or the United States of America and are kept for a longer time than in other regions. Two examples highlighted in case studies below show the challenge of older vehicles: Saudi Arabia's development of its corporate average fuel economy (CAFÉ) standard identified that 21 per cent of the country's light vehicle fleet was older than 20 years and, in Cairo, taxis had an average age of 32 years. This highlights an important policy option for the region. Simple low-cost measures that change the fleet while introducing better data capture are important. By regulating vehicle fuel economy (as Saudi Arabia has done) or requiring imported vehicles to comply with Vehicle Fuel Economy Labelling (VFEL) standards in the country of origin rather than general export specifications with a maximum age for used vehicle imports and requiring importers to lodge annual sales by model and drive train configuration. Currently, few Arab countries have effective transport-sector regulation in place. Algeria has a programme for light vehicle mandatory labelling with compliance reporting; Egypt and the United Arab Emirates promote gas-powered vehicles, buses and taxis; Jordan pursues an electric vehicle programme; and only Saudi Arabia has a CAFÉ-based VFES system for passenger vehicles in place (Box 8).[17]

Freight transport is an inefficient energy user. The heavy vehicle fleet in Arab countries has similar, or more critical, efficiency, emissions, and age challenges as light duty vehicles. Mobility in the region is critical for trade and well-being but is largely locked into high-carbon, road-freight journeys. The fleet in most Arab countries that are not net energy exporters, is in large part composed of imported used vehicles, resulting in low-energy performance for this segment of the sector. A limited application of heavy vehicle Fuel Economy Standards (VFES) is reflected in a low rate of global energy intensity improvement of –0.75 per cent. Saudi Arabia is involved in a Group of Twenty (G20) project to develop heavy vehicle VFES. By simply requiring imported heavy-duty vehicles to comply with VFES standards in country of origin, rather than general export specifications, Arab country heavy duty vehicle fleet efficiencies would converge with these VFEL leaders over the next 10 years. Energy performance would improve further, however, by reorganizing the transportation effectiveness through the introduction of properly designed freight hubs at the national and subregional levels to limit empty vehicle trips and associate with these hubs multimodal transportation (road + rail). Indeed, close to half of vehicles' trips, in the

Figure 32. Urbanization in Arab countries (per cent urban and rural population), 2016



Source: World Bank, 2019b.

absence of such hubs, is made without any freight load, which reduces considerably the effectiveness of freight transportation and its associated energy performance.

Public transport remains underutilized, driving up fuel consumption in the transport sector. In the Maghreb, Algeria, Morocco and Tunisia, as well as Egypt in the Mashreq, have well-established public transportation systems in many cities that contribute to urban mobility in these countries. Larger GCC cities have recently developed passenger rail/metro systems (Dubai, Riyadh, Mecca), although reliance on private vehicles and taxis remains overwhelming. Beyond these centres, the region has a high dependence on low-occupancy motor vehicles. The region has some of the highest local air-pollution and travel-risk levels in the world. Figure 32 highlights the high rate of urbanization in the Arab region. Figure 33 reveals the comparably high rate of private vehicle reliance ("other motorized"). In the sample cities from the Maghreb and Mashreq, public transport accounts for no more than one-fifth of urban transport; in the GCC, these rates are even lower. There is also a noticeable absence of motorcycle use to complement private vehicles, as is the case in Asia, for instance. Together, this highlights a need to focus on sustainable urban mobility systems to deliver SDG social and economic goals, not just efficient vehicle technologies.

Arab cities with metros already offer a growing regional experience in developing new systems and upgrading these sustainable public transport systems. Available data on walking and cycling in 10 cities in the Arab region indicate that people rely on walking and cycling for 20 per cent or more of their urban mobility in half of these cities and that these modes are used for 3 per cent –11 per cent of their urban mobility in the remaining cities. The relatively high levels of walking and cycling in the region's cities indicates a good potential for integration of modes: ride-walk and park-ride connectivity that can enhance the sustainability of urban mobility significantly. Box 8 highlights the wide range of national and urban rail and metro projects underway that promise substantial shifts to sustainable travel modes for the vast majority of citizens that live in, and travel between, urban areas. The region's intercity rail Investments range between USD 10 million/km to USD 30 million/km, and urban metro systems between USD 30 million/km to USD 220 million/km. Given the number of projects underway, a more detailed study of resulting benefits and the contribution to mobility and SDG targets is warranted.

Box 8. Sustainable public transport projects in the Arab Region in 2019

A substantial number of rail and urban metro projects are underway in the region that advance sustainable mobility. Many bus and bus rapid transit projects are also underway but left out of this summary.

Rail, intercity, national projects. Investments range between USD 10 million/km to USD 30 million/km.

Algeria: El-Bayadh–Mecheria railway line; 46 billion Algerian dinars (DZD), due 2020

Bahrain: –GCC Rail link; USD 4 billion, planned

Egypt: Cairo–Alexandria rail modernization; 180 km EUR 70 million, ongoing; Sokna–New Capital–Alamain Rail: 534 km, 13 stops, being planned; Ain Sokna-Helwin rail, being planned; Cairo–Alexandria and Luxor–Hurghada high-speed rail, being planned

Rubiki-10th of Ramadan–Belbeis railway, being planned; Safaga-Qena–AbuTartour rail rehabilitation, being planned

Iraq: Baghdad–Basra high-speed rail; 500 km, USD 13 billion funding; Baghdad–Mosul rail; USD 8.65 billion, planned; Baghdad loop rail, 112 km, under construction

Lebanon: revitalise Beirut–Tripoli railway; 80 km

Morocco: Tangiers-Kentira high-speed rail, 200 km, Moroccan dirham (MAD) 20 billion

Oman: rail, 2,135 km in design

Qatar: long-distance rail (GCC rail project), 350 km, 5 lines, planned; Haramain high-speed rail, 450 km 5 stops, under construction

Saudi Arabia: Al-Jouf–Quiryat extension, planned; Riyadh–Dammam high-speed rail, 480 km, feasibility study GCC railway project, 695 km, planned

Tunisia: Gabes–Port of Zarzis railway, 140 km Tunisian dinars (TND) 240–600 million

Urban metro–tram extensions: Investments range between USD 30 million/km and USD 220 million/km

Algeria: Algiers, metro extension; 54 km DZD 90 billion, completion in 2030; Oran, metro extension: 20 stops, 19.7km, underway; Oran tram extension; 42 stops, 29.6 km, under study; Constantine, 10.35 km 12-stop extension. DZD27 billion, underway

Egypt: Cairo metro line 3 extension Phase 3: 17.7 km, 15 stops EGP 10.4 billion Egyptian pounds (EGP) + EUR 1.5 billion, under construction; Cairo Metro Line 3 extension Phase 4: 11.5 km, 10 stops EGP 5.4 billion + EUR 485 million under construction; Cairo Metro Line 4 extension Phase 1: 19 km, 17 stops EGP 30 billion + EUR 1.75 billion. planned; Cairo Metro Line 5: 24 km, 17 stops, being planned; Cairo Metro Line 6: 30 km, 24 stops, being planned; El-Salam–10th of Ramadan–New Capital light rail transit (LRT): 70 km, 12 stops USD 1.2billion, under study; 6th of October Monorail: 35 km 10 stops, under study; New Capital Monorail: 52 km, 22 stops, under study; El-Raml tram: 13.7 km, 28 stops EUR 363 million

Iraq: Ramli–Abu Qir Tram extension: 22 km, 18 Stops USD 1.7 billion, being planned; Basra elevated metro; 30 km, 15 ,stops 2 lines, contract memorandum of understanding (MoU); Erbil Tramway; 60 km, planned; Karbala monorail; 20 km, 20 stops USD 450 million, planned; Baghdad elevated rail; 20 km USD 1.5billion, MoU; Baghdad metro; Line 1: 21 km, 21 stops, Line 2: 18 km, 20 stops, USD 8.5 billion, being designed; Baghdad River taxi, 22 boats, 9 stops

Kuwait: metro, 160 km, 68 stops, under study

Morocco: Rabat tramway Line 2 extension, 7 km, 12 stops, MAD 1.2 billion, financing; Casablanca Tramway Lines 1 and 2 extensions, MAD 4.3 billion, contracting

Qatar: Doha metro, 3 lines, 75 km, 37 stops; Lusail Tram, 4 lines, 18 km, 25 stops

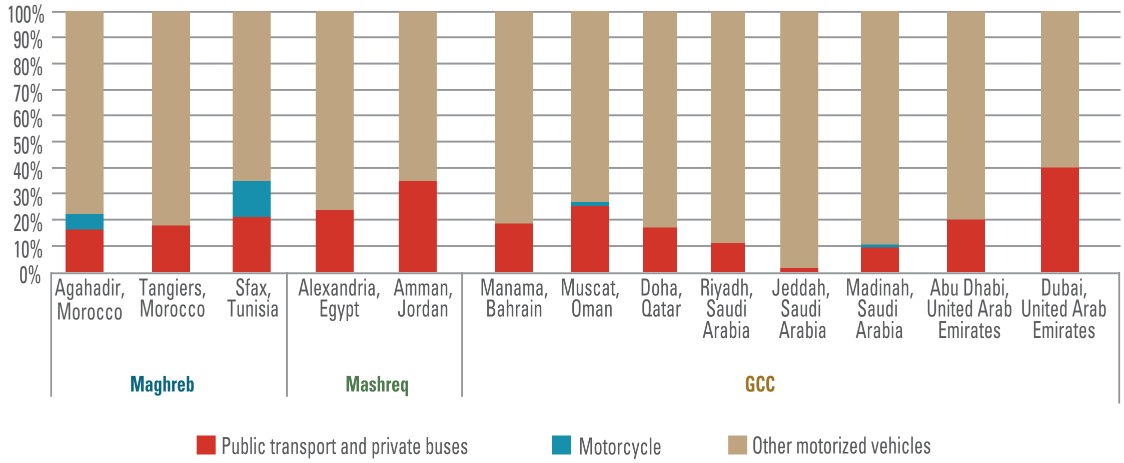
Saudi Arabia: Riyadh metro; 176 km, 85 stops, USD 24 billion; Jeddah commuter railway, 195 km, 20 stops; Jeddah metro 161 km, 71 stops, tram LRT 55 km, 59 stops; Makkah Public Transport Programme 180 km, 88 stops; Madinah metro Phase 1, 32 km 20 stops, initial stages

Tunisia: Tunis Fast Rail Network Phase 1 TND 3 billion; Sfax Public Transport Network, 70 km 115 stops TND 2.8billion

United Arab Emirates: Abu Dhabi light rail network, 50 km, 77 stops, planned; metro 62 km, 27 stops, planned. Tram extension, Phase 2, 6 km, 9 stops, Phase 3, 16.6 km 19 stops, on hold; metro extension "Route 2020" 15 km 7 stops, under construction; metro upgrades, red line, 3.5 km; green line, 20.6 km, 12 stops; purple line 49 km, 15 stops; gold line; hyperloop being planned

Source: International Association of Public Transport, 2019.

Figure 33. Urban motorized travel modes in selected Arab cities (2012-2018)



Source: International Association of Public Transport, 2019.

Box 9. Sustainable transport policies in Saudi Arabia

The Saudi Arabian transport sector uses 1 million barrels of oil equivalent per day (6.1 PJ/day, 2.2 EJ/year) or 21 per cent of Saudi Arabia's total final consumption (TFC). Passenger light duty vehicles (LDVs) use 52 per cent of this, and freight heavy duty vehicles (HDV) 40 per cent, the balance being in aviation and maritime transport. While 0.7 million new cars are sold each year into a stock of 12 million cars, 2.5 million are more than 20 years old. The average fuel economy of new vehicles in 2012 was 12.2 km/l, lower than international benchmarks such as the European Union 18.2 km/l, Japan 19.7 km/l, China 15l/km and the United States of America 12.8 km/l. Projections show transport energy doubling from 2016–2030 if no action is undertaken. Five policies have been developed to address this. Three are already underway.

The Saudi CAFÉ fuel economy standard was implemented in 2016 to improve fuel economy from a baseline 2 per cent improvement between 2012 and 2015 up to a 9 per cent improvement between 2016 and 2018. Used vehicle imports are required to meet a minimum energy performance standard (MEPS) level over 10.3 km/l for passenger cars and 9 km/l. for light trucks. Agreements signed in 2014 between the Saudi Government and more than 80 automobile manufacturers, representing more than 99 per cent of the Saudi market, mean each will meet the CAFÉ standards. Prior to the CAFÉ standards, fuel economy improved at 1.1 per cent CAGR (2102–2015). Projections were that fuel economy would increase to 4.3 per cent CAGR for 13.6km/l from 2016 to 2018, and then at 5 per cent CAGR to 19km/l from 2019 to 2025. Without the standards it would be 14.8km/l: a 28 per cent improvement in fuel economy.

A **fuel economy label** has been required upon sale of new cars since August 2014 and was upgraded with an additional "+excellent" category in response to higher efficiency models. An electric vehicle energy-performance label and promotion of high-efficiency diesel vehicles and fuel price reforms until 2021 complement the regulations. A **tyre low-rolling resistance standard** was implemented in November 2015 and includes test facilities. Fuel reductions of 2 per cent –4 per cent for LDVs and 6 per cent –8 per cent for HDVs are expected. Saudi Arabia is part of a G20 process analysing fuel economy measures for HDVs. HDV fuel economy measures including idle-stop and aerodynamics are under assessment. Fuel reductions of 5 per cent –9 per cent are anticipated, implementation is targeted for 2021. An **accelerated retirement scheme for older vehicles** is being assessed.

Sources: Saudi Energy Efficiency Center, 2018a.

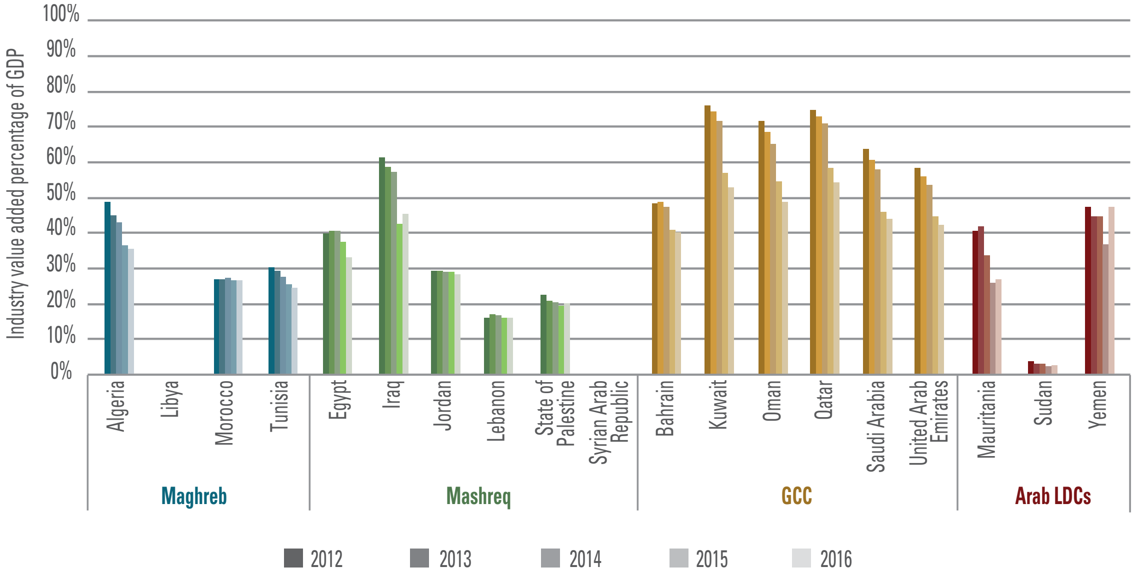
Rationalizing energy use in the transport sector is a key challenge for the Arab region. Transport is an important consumer of energy, accounting on average for at least one-third of total final energy consumption, with a larger share in the Maghreb and Mashreq countries. Increased need for mobility over the coming decade is likely to continue to push up the transport sector's energy needs, making this sector key to managing energy consumption in the coming decades. As the share of renewable energy becomes more significant in the energy mix, electric vehicles would be an economic path to more efficient, sustainable travel, hence contributing to meeting the SDG 7.3 target for energy efficiency, but also being a way of providing valuable energy storage to improve the performance of the new renewable power plants. Electrical vehicles would hence be a valuable asset in meeting the SDG 13 climate objective.

Industries

The industry sector is still operating below international energy efficiency benchmarks. In 2016, the industrial sector spent 7.86 EJ or 42.8 per cent of the region's final energy, including for non-energy use. This represents a 14 per cent higher share of final energy than the world average, reflecting the structure of large-scale energy extraction and processing activities. The share of the industry's value added differs considerably across Arab countries, ranging in 2016 from about 3 per cent in the Sudan to 16 per cent in Lebanon, 26 per cent in Morocco and 43 per cent in Saudi Arabia. Figure 34 Shows the evolution of the share of industry of the total value added of Arab countries for the period 2012–2016. Most countries have seen a general pattern of reduction in industry value added over the past years as their economic activity mixes shift increasingly to services. In the more heavily petrochemical industrialized countries—GCC, Algeria and Iraq—there was a distinct drop in industry value added contribution from 2014 as oil prices fell.

Fossil fuels dominate industrial activity in the region's oil exporters. Oil and gas exports dominate industrial activity in the Arab region's large oil exporters—Algeria, Bahrain, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia and United Arab Emirates—making up more than 50 per cent of industrial value added. Industrial

Figure 34. Industry value added in the Arab region (per cent of total), 2012–2016

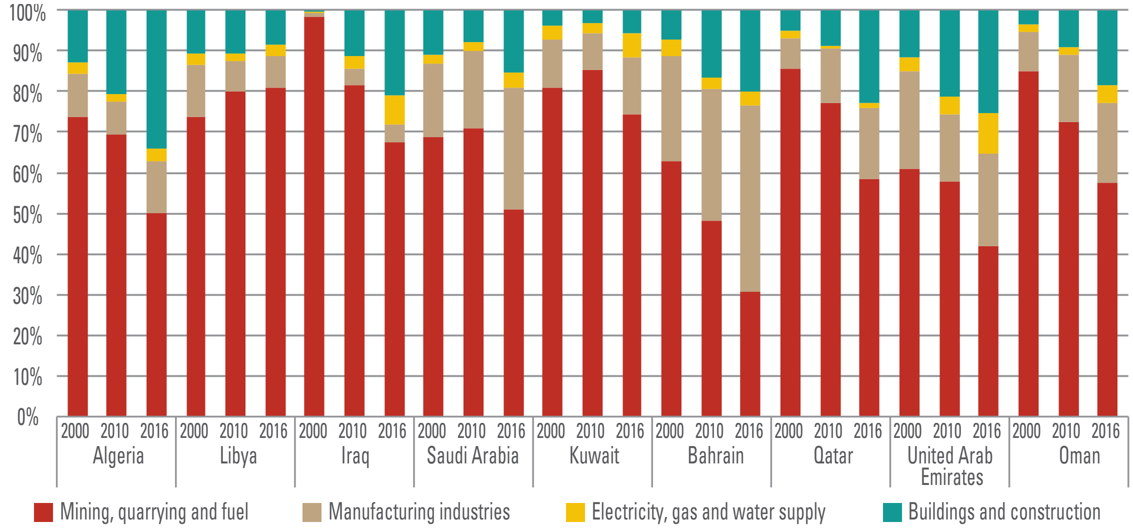


Source: World Bank, 2019b. Industry (including construction), value added (percentage of GDP). No data available for Libya and Syria.

structure shifted as fuel export value dropped both as oil prices fell away in 2014 and as processed metal and manufacturing grew. Bahrain, Saudi Arabia and United Arab Emirates are economies where policies to develop service sectors and downstream value-adding activities from oil resources, have increased manufacturing since 2010. Bahrain trebled value added from manufacturing in 2016 to 18 per cent of GDP.

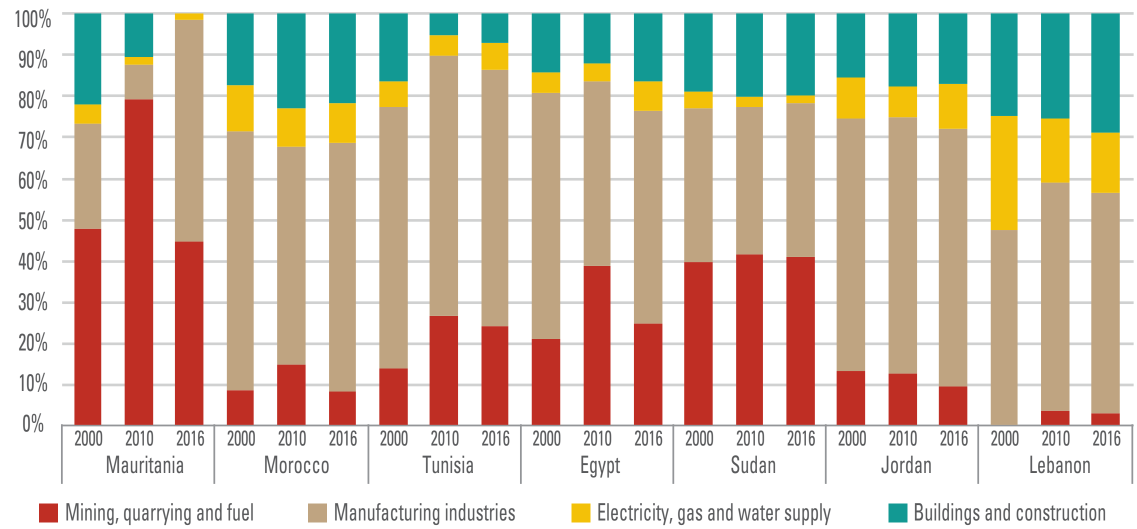
Oil exporters rely more heavily on energy intensive industries than the regional average. As a result of its comparative advantage in oil resources, Arab region countries often have a higher-than-normal distribution of intensive energy-consuming industries (IECI). This is explored in the ESCWA publication Energy Efficiency Indicators in Intensive Energy Consuming Industries (ICenergy intensity) in the Arab Region,[18] including petrochemical and

Figure 35. Oil-exporting Arab countries' industry value added structure (percentage of total), 2000–2016



Source: Arab Monetary Fund, 2019.

Figure 36. Oil-importing countries industry value added structure (percentage of total), 2010–2016



Source: Arab Monetary Fund, 2019.

Table 2. Industrial policies in Arab countries in 2016

Country And allotted RISE score for industry (based on a maximum score = 100)	**MEPS**	**Other policies**
Algeria 58		Mandatory energy efficiency targets, audits and reporting and computerized energy management systems, incentives for large-scale users, reporting, penalties for non-compliance, measurement and verification (M&V) system, recognition and publicity for energy cost reductions, Tax and financial incentives
Bahrain 0	-	-
Egypt 92	Industrial electric motor MEPS Compliance reporting and penalties	Mandatory energy efficiency targets, M&V audits and progress reporting, penalties for non-compliance, tax incentives, ESCOs, SME programme, recognition and publicity for energy cost reductions
Iraq	N/A	N/A
Jordan 58	-	Energy targets and mandatory audits, reporting M&V and some SME programming, recognition, assistance to identify energy efficiency investments.
Kuwait 25	-	Publicity for achievement, assistance to identify energy efficiency investments
Mauritania 0	-	-
Morocco 13	-	Mandatory energy efficiency targets, progress-tracking audits and progress reporting, penalties for non-compliance, Tax and financial incentives
Lebanon 58	-	Energy targets and mandatory audits, progress tracking, energy management systems, reporting, SME programme, energy efficiency incentives
Libya	N/A	N/A
Oman 8	-	Targets and progress tracking
State of Palestine	N/A	N/A
Qatar 33	Electric motors and other equipment	Energy targets and mandatory audits, reporting, progress tracking, energy management systems, penalties for non-compliance and periodic reporting, M&V, public recognition, energy cost savings publicity
Saudi Arabia 42	Electric motors	Targets, mandatory audits and progress tracking, penalties for non-compliance and periodic reporting, M&V, public recognition, energy cost savings publicity, assistance to identify energy efficiency investments
Sudan 33	Electric motors	Targets and audits, energy-management systems, penalties for non-compliance, energy efficiency incentives
Syrian Arab Republic	N/A	N/A
Tunisia 88	-	Targets, audits and energy management systems, penalties for non-compliance, periodic reporting, energy efficiency incentives, SME programme, recognition, publicity for energy efficiency and assistance to recognize energy efficiency opportunities
United Arab Emirates 54		Tracking energy use for large consumers, periodic reporting, incentives, recognition, publicity for energy cost savings, assistance to identify energy efficiency investments, assistance from government
Yemen	-	-

Source: Derived from World Bank, 2019e; World Bank, 2017c.
(RISE: Regulatory Indicators for Sustainable Energy, developed by the ESMAP programme of the World Bank)

chemical processing, basic metals and metal-processing plants (iron and steel, aluminum). Even in Egypt, which is not a large oil exporter, 60 per cent of industrial energy use is in these energy-intensive processes, whereas the global average is around 50 per cent. These energy intensive industries hold a high potential for energy cost-and greenhouse-gas (GHG) reductions, globally. Smaller and older energy intensive plants tend to have higher specific energy intensities and are prime candidates for process upgrades or replacement with modern process plants. Where Arab countries have modern large-scale industrial plants, they can be at the forefront of global energy efficiency and can have relatively low GHG footprints. For example, Arab region CCGT-powered basic metal plants often have relatively low carbon footprints as their power supply and processes are more efficient than in many other countries with older plants and coal-fired power stations.

Oil-importing countries have more diversified industrial structures. Without oil dominating the industrial sector, these countries have a much more balanced—albeit with much lower overall value—industrial structure. The manufacturing sectors in Egypt, Jordan, Morocco and Tunisia have generated at least 50 per cent of the value added of the industrial sector since 2000.

Industrial energy efficiency policies in the Arab region are a mix of voluntary and mandatory energy audits requirements and targets. In this context, and most importantly for the Arab region's oil-importing and LDC countries, project-based initiatives are often key to advancing industry productivity (Table 2). Only four Arab countries have electric motor efficiency regulations. Most countries have energy targets for industries. While the impact of these depends on a wide range of enablers, they have the potential to drive substantial energy efficiency improvement if they are evaluated and supported.

Across the region, countries can better identify subsectoral value added energy relationships in their industry and service sectors to identify more effective policy programmes to deliver on SDGs. Improving the focus of the industrial targets and developing capacity in energy management techniques remains central to advancing industry energy efficiency. Industrialized Arab countries have developed power and water sectors, where primary fuel transformations and emissions occur. Industrial sector emissions are relatively lower than industrial sectors in other countries as the dominant industrial energy sources are electricity and gas, relatively low emission fuels and coal not widely used. The structure and product mix of each country lead to a moderate emission profile in some Arab economies.

Agriculture

Agriculture forms an important part of the economies of a number of Arab countries, in particular Egypt, Jordan, Lebanon, Mauritania, Morocco, the Sudan and Tunisia. The sector's performance is already challenged by changing weather patterns affecting productivity and energy intensity with increasing demand for irrigation and increased mechanical ventilation of facilities for livestock. Climate change will likely accelerate these challenges over the coming decade (Chapter 4). Changes in global demand and food prices impact on the economic value created by this sector for exporting countries, while agriculture is also integral to many Arab countries' food security.

Accelerating energy intensity improvements will be a priority for agricultural producers in the Arab region. Energy efficiency improvements contribute to resilience-building and protect agricultural livelihoods as energy needs and costs will only increase in the coming years and decades. Required policies include those targeting access to modern energy sources, and energy- and water-efficient technologies for use in the agricultural sector. Agriculture policies in the region should be considered in the context of regional nexus strategies that integrate energy–water–land use productivity to focus activity on the sustainable utilization of arable land and water resources where they are available and discourage it where environmental impacts and costs are high.[19] Trade is critical to food security and SDG ambitions for the whole region.

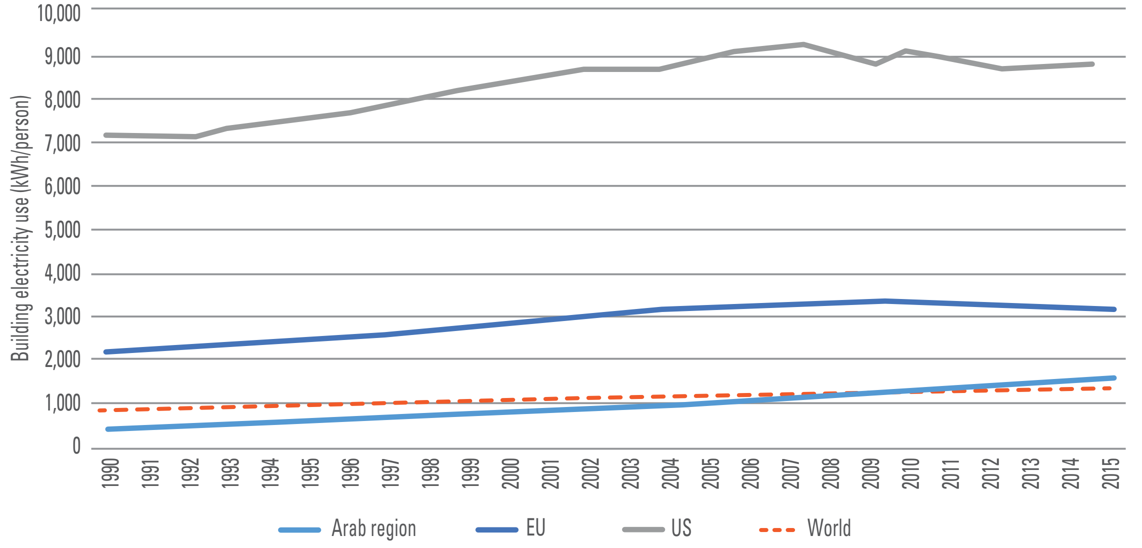
Residential and commercial buildings

Building energy intensity is growing in the Arab region. Albeit starting from a comparably low starting point by global comparison— around 96 kWh/m²/year in 2012 (the latest year available), 40 per cent lower than the world average of 165 kWh/m²/year[20]—residential and commercial energy consumption is likely to increase over the coming decades. Past low rates of energy intensity in buildings relates not necessarily to highly energy efficient homes, but mainly because of low heating requirements in areas with mild-to-hot climates and suppressed demand for air conditioning and other home appliances in many countries. The GCC is a notable exception in this context, with very high rates of air-conditioning use.

Building energy consumption is expected to increase in the Arab region. Rising living standards and incomes, with home appliances becoming affordable to larger segments of the population, along with climatic factors that include hotter weather across the region and buildings that were/are built, in most case, using designs and materials that are not the most appropriate to meet these challenges, are all factors that combine to drive up building demand for energy substantially throughout the Arab region over the coming decades. Figure 37 illustrates this trend of rising energy consumption in buildings in the Arab region; in other world regions with established appliance MEPS and building codes, such as in the US and EU, electricity has dropped off over the past decade as higher efficiency appliances are replacing older, less-efficient stock over time.

Building energy efficiency is increasingly being recognized as a policy-relevant factor in the Arab region. Most countries in the Arab region have in the past developed energy efficiency regulations in buildings (Table 4). However, persistent challenges include lack of legislation vigour, lack of functioning enforcement mechanisms and adequate monitoring and, in some cases, incomplete or inadequate legislation. Effective building sector regulation is important not only to achieve net-savings in building energy use and reduce the sector's energy intensity, but also to ensure that wider reforms, particularly energy prices' reforms for domestic consumers are equitable and socially responsible. ESCWA Energy Vulnerability in the Arab Region Report notes in this respect that

Figure 37. Regional building electricity use (kWh/per capita/year)



Source: ESCWA, 2018a.

"Building developers have no incentive to build more efficiently without regulation, regulatory enforcement and financial incentives to invest in more energy efficient buildings. There is a lack of stock of affordable energy efficient buildings with clear and transparent labelling for tenants. Given the large proportion of rented accommodation, tenants with average income ranges often have no choice and end up bearing the cost of rising electricity bills while having no influence on the efficiency of building materials and design.

… The revision of decades-old electricity subsidies while national building stocks remain poorly equipped to ensure an efficient use of energy, raises concerns of long-term affordability of electricity in the Arab region. This concern is amplified by the impact of climate change, which over the coming decades is expected to affect Arab countries with ever more extreme weather conditions, including colder winters in Maghreb and the Mashreq and hotter summers in the Gulf States and Arab LDCs." [21]

Improved energy efficiency in the building sector has many potential benefits for the region. Improved building performance offers citizens and societies obvious benefits in reduced energy consumption,

Table 3. Building code and MEPS coverage of final energy for Arab countries by mid-2019

Country	Appliance MEPS and labelling			Building codes		
		Allotted RISE-2018 EE score for MEPS (based on a maximum score=100 for highest performance)	Allotted RISE 2018 EE score for labelling (based on a maximum score=100 for highest performance)		Code type	Allotted RISE 2018 EE score for building codes (based on a maximum score=100 for highest performance)
Algeria	Air conditioners, freezers, refrigerators, lighting labelling since 2009	22	100	Residential and commercial building envelope insulation, 2005. Third- party verification also renovations	p M (D)	37
Bahrain	Air conditioner labels since 2015, also household light bulb MEPS 2015	25	19	Commercial building, thermal Insulation (1999) other building types (2013), also rating labels and renovations	p M (D P)	20
Egypt	Air conditioners, freezers, refrigerators, washing machines labelling 2006. Lighting MEPS 2009	38	69	EE code for residential (2005), commercial, public buildings (2009)	P p M (D)	27

Country	Appliance MEPS and labelling			Building codes		
Iraq	N/A	N/A	N/A	EE Specifications for Buildings (2012)	p V	NA
Jordan	Air conditioners, freezers, refrigerators, washing machines, lighting labelling since 2014	43	56	Energy conservation building code (2010), residential and commercial	p M (D)	73
Kuwait	Air conditioners, since 1983 as part of building code. Revised., 2010, 2014. Lighting MEPS 2014	10	0	Energy conservation code of practice No. R-6 (1983, updated 2014) Residential and commercial. Also targets	p M (D)	57
Lebanon	Voluntary codes for refrigerators since 2008, air conditioners since 2007. Lighting MEPS under development	13	38	ARZ Building Rating System for Existing Buildings (LBGC, 2011)	P V	33
Libya	N/A	N/A	N/A	N/A	-	N/A
Mauritania	N/A	0	0	N/A	0	0
Morocco	Energy labelling standards and MEPS under development	32	81	Energy efficiency code (2015) Residential and commercial buildings, third-party testing. Also targets.	p P M (D)	60
Oman	N/A	35	38	NA	-	5
State of Palestine	N/A	N/A	N/A	Energy efficiency code for buildings (2004)	p V	N/A
Qatar	Air conditioning 2013. Freezers, refrigerators 2016. Washing machines 2016. Lighting 2016. MEPS and labelling	45	19	Global building assessment system New public buildings (2012) New commercial buildings (2016) New residential buildings (2020) Sustainable building labels	M (D)	80

Country	Appliance MEPS and labelling			Building codes		
Saudi Arabia	Air conditioners 2018, freezers, refrigerators, 2018, washing machines 2018; Clothes dryers 2017 Water heaters 2017: MEPS, labelling	60	81	Thermal performance code (2014) new and renovated	p M (D P)	37
Sudan	N/A	17	0	NA		0
Syrian Arab Republic	Refrigerator regulation 2008 Compact fluorescent lamp (CFL) and linear fluorescent lamps label	N/A	N/A	Thermal Insulation code (2009)	p M (D)	N/A
Tunisia	Refrigerators and freezers 2009 Air conditioners 2012; MEPS and labelling. Lighting MEPS 2011	50	75	Residential code (2009). Selected commercial and institutional buildings (2008)	p P M (D, C, P)	87
United Arab Emirates (Dubai)	Air-conditioning systems, water heaters, refrigerators, washing machines, dishwashers since 2013	42	56	Thermal Insulation requirements (2003) Green building regulations and specifications (2011)	p P M (D)	67
Yemen	N/A	0	0	N/A		0

Note: M = mandatory; V = Voluntary; P = Performance based, p = prescriptive based. (D) = design plan review, (C) = construction inspection, (P) = occupancy permitting

Source: ESCWA, 2018a and World Bank, 2017c.

peak demand and direct reductions in emissions. They also receive improved comfort and safety, while upstream utility system operators benefit from reduced investment in new T&D infrastructure and reduced need for reserve power generators. US studies show that investment in residential energy efficiency offers utilities upstream cost savings in the order of 140 per cent of investment in consumer energy efficiency[22]. An analysis of a potential large-scale building retrofit programme in Saudi Arabia[23] identifies potential to avoid the construction of 23 GW in power-plant capacity and the consumption of 100 TWh of electrical energy per year. In addition, a substantial retrofit programme would create 247,000 new jobs per year over a 10-year implementation period. A potential 38 GW of photovoltaic (PV) capacity can be added to roofs of buildings in Saudi Arabia, offering 51 TWh/year generation capacity and avoiding 29 Mt of CO_2 (ESCWA 2019a; see also Chapter 4).

Box 10. Capacity building supports building energy efficiency policies in Saudi Arabia

Saudi Arabia's building codes for low and high-rise building include 14 insulation standards. 100 million m^2 of buildings are built each year with the new codes. Appliance regulatory standards include: small and large air conditioners, refrigerators and freezers, washing machines and clothes dryers, water heaters, lighting products. The air-conditioning standards increased efficiency by 57 per cent in 2018. Some 20-25 million air conditioners will be retired and replaced by new efficient models in a decade. A new incentive discounting the purchase of high-efficiency air conditioners from 2018, complements the MEPS. 90-120 million lights will be replaced with high-efficiency lamps.

New national companies are being established to add capacity:

- A super-ESCO Tarshid (case study in Box 5) for government and commercial building retrofits;
- A National District Cooling Company with a 15-year SAR 60 billion budget for 6–9 Mt of high-efficiency refrigeration capacity;
- National testing laboratories to support appliance standards.

These companies fast track new industry capability to ensure normal stock turnover is replaced with high-efficiency solutions, complement product-efficiency regulations, and create thousands of new skilled jobs contributing to economic diversification.

Capacity building is crucial to long-term success. The Saudi Energy Efficiency Centre (SEEC) has worked to establish five university energy efficiency courses with 270 students, industry skills certification for 180 experts in monitoring, verification, energy audits and energy management, and a centre of excellence in energy efficiency at the King Fahd University of Petroleum and Minerals. The programme is successful as it is well integrated across 30 government entities and state enterprises, has a marketing programme running over 50,000 advertisements, with substantial digital media. Compliance with regulations is well enforced with six agencies committed to enforcing standards and testing. Over 37,000 factories, warehouses and retailers have been visited, 5,000 infraction notices issued, 75 non-compliant factories closed, and 2.1 million non-compliant products confiscated.

The Saudi Energy Efficiency Centre (SEEC) leads energy efficiency policy implementation. Its mandate was renewed in 2018 with its scope of work expanded beyond end-use sectors to include: power generation transmission and distribution, water desalination, and feedstock use in industry.

Source: Saudi Energy Efficiency Centre, 2018b.

Table 4. Potentials to reduce energy use and related emissions in the Arab building sector

Technology	Avoided electricity use (TWh/year)		Avoided energy cost (USD millions/year)		Avoided carbon emissions (Mt/year)	
	2025	2030	2025	2030	2025	2030
Lighting	7.0	13.9	357	722	4.4	8.8
Improved Air conditioner MEPS	6.4	11.3			4.0	7.0
Refrigerator MEPS	6.972	13.851	357.5	721.8	4.358	8.756
Cumulative totals for 2020–2030		371 TWh				230 $MtCO_2$

Source: ESCWA 2019, based on U4E (2017) and estimated based on IEA carbon emission factors for each country (International Energy Agency, 2017).

Box 11. Emerging energy efficiency in the Sudan

Energy-use patterns and practices in the Arab LDCs are different from those in other Arab countries. The Sudan has an ambitious nationally determined contribution (NDC), but, like other LDCs, is still developing the capacity to deliver. The Sudan's National Energy Efficiency Action Plan (NEEAP 2013–2016) planned total energy savings of 4.5 per cent by 2016 and 24.6 per cent by 2020 from the base year of 2013. TPES grew by 20 per cent to 773 PJ in 2016 as the Sudan met its growing population needs.

In order to work towards its targets, the Sudan joined the UN's Global Efficient Lighting Partnership Programme; enlighten, with plans to distribute around one million compact fluorescent lamps (CFLs). In addition, the Sudan operates a pre-paid meter programme managing revenue and prompting conservation, reducing non-technical losses in distribution networks and improving payment rates with energy bill collection. In 2016, the government raised the price of gasoline and diesel, to reduce energy subsidies. The Sudan is also establishing a labelling system for electrical appliances. Evaporative cooling (water coolers) is common in the Sudan. In Khartoum summer (July) wet-bulb temperatures reach 23°C, ideal for evaporative cooling. They provide effective and efficient cooling given income and supply constraints in arid LDC communities. The Sudan also sits with Iraq, Kuwait, Libya, Mauritania, Oman and Yemen in the lower quartile for policy framework and institutional capacity in the Regional Centre for Renewable Energy and Energy Efficiency's 2017 Arab Future Energy Index analysis. The Sudan's energy efficiency policies need rapid capacity building for quick implementation in both services needed, improved access to electricity and to minimize supply costs. A focus in the industrial sector and establishment of energy efficiency regulations will improve the country's implementation and enforcement of planned energy efficiency measures.

Power-system operators in LDCs are often best placed (often the only capability) to develop sustainability in energy. Often state-owned, they can directly transpose government ambition into action with their technical and financial capabilities, customer and system operational information, and can capture the value in upstream cost reductions from downstream energy efficiency and distributed renewable energy investments. The National Electricity Corporation of the Sudan is a statutory corporation under the Ministry of Energy and Mining, is already actively managing demand, ensuring power factor is controlled. It is well placed to expand its scope to deliver the Sudan's energy efficiency ambition. LDC governments can best accelerate energy efficiency by creating a mandate for their power-system operators to advance energy efficiency, adopting regional best practices in energy efficiency regulations, and establishing Super ESCO financing capabilities.

Sources: Regional Center for Renewable Energy and Energy Efficiency, 2017; University of Khartoum, 2003; 2010.

Table 5. Country energy efficiency policy progress and challenges

Country	Allotted RISE overall EE Score for 2016 (based on a maximum score=100 for highest performance)	Allotted RISE overall EE Score for 2018 (based on a maximum score=100 for highest performance)	Key EE policies' strengths and challenges, with indication of associated 2018 RISE scores for particular issues (based on a maximum score=100 for highest performance for each item)
Algeria	55	55	Strengths to be reinforced: planning (87), institutions (79) labelling (100) and electricity rates structure (89) Challenges to be addressed: MEPS (22) and financing mechanisms (33)
Bahrain	27	28	Strengths to be reinforced: planning (100) and institutions (100) Challenges to be addressed: MEPS (25) and labelling (19) are weak, but even more challenging is the lack of incentives (0), finance (0), mandates (0)
Egypt	48	61	Strengths to be reinforced: planning (77), institutions (100) incentives (74) and finance (73) Challenges to be addressed: MEPS (38), incentives for utilities (33)
Iraq	N/A	N/A	Challenges to be addressed in all EE policy areas
Jordan	55	57	Strengths to be reinforced: planning (87), institutions (100) and electricity rates structure (89) Challenges to be addressed: labelling (56), MEPS (43) should be improved, incentives for utilities (4) is critical weakness
Kuwait	30	28	Strengths to be reinforced: planning (77). Challenges to be addressed: incentives for utilities (0), institutions (39), financing (0) MEPS (10), labelling (0)
Lebanon	35	52	Strengths to be reinforced: planning (93), institutions (68), Incentives (75) Challenges to be addressed: MEPS (13), labelling (38)
Libya	NA	NA	Challenges to be addressed in all EE policy areas
Mauritania	9	11	Further development is needed for: electricity rates structure (59) and electricity use information (56) Challenges to be addressed: all other policy areas.
Morocco	42	56	Strengths to be reinforced: Planning (80), Institutions (100) Labelling (81) Financing (82) and electricity rates structure (96) Challenges to be addressed: MEPS (32) and end users / public sector incentives (13/13)

Country	Allotted RISE overall EE Score for 2016 (based on a maximum score=100 for highest performance)	Allotted RISE overall EE Score for 2018 (based on a maximum score=100 for highest performance)	Key EE policies' strengths and challenges, with indication of associated 2018 RISE scores for particular issues (based on a maximum score=100 for highest performance for each item)
Oman		35	Strengths to be reinforced: planning (67), institutions (100) and electricity-rates structure (78) Challenges to be addressed: financing (0), MEPS (35), labelling (38), end-users incentives (8), utility incentives (0)
Qatar	50	40	Strengths to be reinforced: Public sector incentives (88) and institutions (68) Challenges to be addressed: financing (0), labelling (19) utility incentives (25), end-users incentives (33)
Saudi Arabia	50	59	Strengths to be reinforced: planning (100), institutions (100), public sector incentives (75), labelling (81), electricity-rates structure (91) Challenges to be addressed: utility incentive and mandate (17)
Sudan	19	24	Strengths to be reinforced: planning (77) Challenges to be addressed: Institutions (21) incentives for end-users (33) public sector (0), financing (0), MEPS (17) and labelling (0)
Syrian Arab Republic	N/A	N/A	Challenges to be addressed in all EE policy areas
Tunisia	68	74	Strengths to be reinforced: planning (87), institutions (100), electricity-rates structure (85), incentives for end-users (88), public sector incentives (100), financing (75), labelling (75) Further development is needed for: MEPS (50), consumer information (53)
United Arab Emirates	63	65	Strengths to be reinforced: planning (73), institutions (100) consumer information (83), electricity-rates structure (100) Further development is needed for: MEPS (42), incentives for end-users (54) and public sector (50)
Yemen	13	11	Further development is needed for: capacity in planning (57) consumer information (42) Challenges to be addressed: all other policy areas.

Policy implications

Energy efficiency requires substantial progress through policy action in the Arab region. In many countries, energy efficiency policies have not yet matured into institutional capacity, implementation progress and evaluation. Creating substantial improvement in energy efficiency requires synergies across policies, prices, regulations, market influencers, compliance management and enforcement to work together. Those countries that have made the best progress in the past two years are aligning and integrating policies to achieve the necessary changes. Integrating energy efficiency action plans into development strategies, requires clear SDG targets for each country, identifying required capacity building needs, human and financial resources, making the necessary policy and regulatory reforms and developing the required implementation mechanisms.

Transport energy intensity is highest of the world's regions, but vehicle ownership is low by global standards, implying a pent-up demand for increased mobility. Public transportation has only been developed in parts of the region, but a range of sustainable public transport projects are being implemented and will improve mobility and sustainability of travel in many countries in the region. Much greater efforts are needed to overcome the general lack of data and improve the understanding of transport energy efficiency issues in the region. Policies to improve transport vehicle and system-energy efficiency, reduce high levels of local pollutants, and global emissions, are only available in a few countries in the region and should be reinforced and generalized to include the remaining countries. The oldest and worst polluting vehicles, especially those with the highest mileage (taxis and couriers), should be displaced by integrating regulations and technical and financial solutions. Experience in Egypt in vehicle scrapping can be used as a model for such programmes.

Special policy attention needs to be given to energy intensive industries (representing more than 70 per cent of industry's energy consumption in many countries in the region). Specific measures need to be developed to increase their energy productivities, such as cogeneration and other appropriate actions. Industrialized countries in the region, with exporting industries, should capitalize on the region's competitive advantage in low energy costs, and enhance their global competitiveness by improving their energy efficiency. Industrial energy efficiency policies need to gain in maturity in many countries, and largely voluntary energy performance requirements should become mandatory, particularly by enforcing relevant equipment MEPS. Examples of advanced energy efficiency programmes exist in some industries, but most countries need capacity building and investment programmes to achieve international benchmarks of energy productivity, using appropriate technologies and industrial processes. Substantial efforts need to be made to understand the dynamics that make these industries operate with such low energy performance. It is imperative that the industrial operators in the Arab region have access to global information, technology and financing opportunities, including properly designed incentives, to reach global advances in energy efficient technologies.

The building sector requires separate attention. Most countries have building codes and appliance standards for air-conditioners, and refrigerators. Developing compliance with these standards and establishing realistic and evolving MEPS is a priority to achieve improved well-being in buildings and avoid unnecessary investment in peak demand capacity in power sectors. Energy demand reductions from energy efficiency are unlikely in LDCs as any efficiency gains would be used to meet increased levels of essential services and improved well-being and would not be visible as energy cost savings. Arab LDCs have a pent-up demand for improved well-being and economic services and a particular need for cooling and water supply as climate impacts develop. Advancing energy efficient cooling systems and water efficiency measures enables better critical services and lowers the costs of extending constrained energy supplies.

Demand-side management (DSM) offers both consumers and energy suppliers cost

efficiencies by minimizing peak power demand. DSM techniques include: storing energy; shifting demand peaks to lower demand periods; cutting demand peaks with energy efficiency or distributed generators; and reducing the baseload below demand peaks with energy efficiency. These are typically motivated by consumers receiving cost-reflective time of use price tariff signals that reflect the demand peaks faced by power suppliers. The upstream benefits to suppliers are significant, but critically rely on effective consumer motivation to act. In countries with energy subsidies, consumers, even those with a low preference for electricity, have little motivation as subsidized averaged rate tariffs offer little return or motivation for energy efficiency or DSM actions. There are, as a result, few price-motivated DSM programmes; regulatory actions are required to compensate for the lack of price motivation.

Sustainable DSM programmes in the Arab region therefore need to also look at actions that motivate change with fixed or low energy tariffs. Summer peak or capacity charges for commercial buildings make sense as they motivate reductions in both baseload and peak capacity and can be complemented by direct investment by power suppliers in electricity efficiency measures. These end-use energy efficiency measures are important, every kW of demand reduction can also create a further 0.2–0.3 kW of air-conditioning demand reduction. Power suppliers should therefore assess the economics of investing directly in demand-reducing energy efficiency programmes options such as energy and electricity peak demand audits, free LED lamps, insulation upgrades, air-conditioner performance audits and upgrades, and distributed PV, in areas with supply constraints.[24]

Arab countries need to build institutional capacity to deliver energy efficiency. This includes the development of integrated energy efficiency and renewable energy policies and institutions; and the review and re-development of country targets for energy efficiency and renewable energy to match country societal and economic development ambition, SDG goals, and local environmental challenges, and mobilize the necessary human and financial means to achieve the retained targets. Requiring utility suppliers to invest in end-use efficiency and distributed renewables will help this goal, while power sector regulations and practices should enable consumers to invest in their own energy efficiency and renewable energy solutions. Arab countries also need regulatory policies and attractive implementation schemes to ensure a sufficient impact that can overcome the lack of economic incentive for consumers where necessary.

Effective policy design requires data transparency, availability of information and monitoring to ensure compliance with existing codes. Progress in energy efficiency requires significant improvement in country and sectoral energy and activity data collection and analysis; clear, transparent monitoring, reporting and verification (MRV) schemes that allow qualification and quantification of actual progress, identifying synergies in energy efficiency and renewable energy progress. Given an established base of appliances and buildings' energy performance policies in the region, priorities must focus on ensuring a high level of compliance with the policies; understanding the efficacy of the policies—are they really achieving their potentials?; maintaining effective review and revisions; collaborating to harmonize country standards around global standards and best regulatory practices as technologies advance; and ensuring industry is supported with accredited test facilities.

Programme evaluation needs to be improved. The potentials and risks, capital investment performance, the prospects of further declining costs for energy efficiency in the Arab region have different drivers than in other regions. The multiple benefits from energy efficiency investments that are delivered in developing and emerging economies may be much greater than in developed economies as they free up constraints in resources to open up new development opportunities. The impacts of improving energy efficiency across other SDG goals have yet to be developed in the region, highlighting that programme evaluation needs improvement.

3. Renewable Energy

SDG 7.3 tracks progress in the share of renewable energy in total final energy consumption (TFEC) towards the ultimate goal to substantially increase, by 2030, the share of renewable energy in the global energy mix. This chapter presents main findings for the Arab region, looking both at the share of renewable energy and actual consumption dynamics in modern renewable energy use.

Main messages

- **Regional trend.** The share of renewable energy in TFEC has been in slow decline in the Arab region. This historical long-term trend, which runs contrary to global use patterns, as well as the SDG target for renewable energy, reflects the high share of solid biofuel in total regional renewable energy consumption, whose use has been steadily declining. Consisting mostly of traditional biomass, solid biofuels have seen shifting consumption patterns as more households access electricity and liquid fuels. The share of renewable energy has been plateauing at around 10.2 percent of the Arab region's TFEC since 2010, declining by another 11 percent between 2014 and 2016. The share of modern renewable energy technologies—solar, wind and hydropower—lay at 19 percent of the region's total renewable energy consumption in 2016, and has been increasing, albeit at very slow pace.
- **2030 target.** With declining shares of renewable energy in TFEC, the Arab region seems far off SDG target 7.2. ("By 2030, increase substantially the share of renewable energy in the global energy mix"). This overall trend reflects to a large extent a declining use of traditional biomass in favour of more modern, higher-quality liquid fuels and electricity, indicating a welfare gain to Arab societies from the current trend. On the other hand, the use of modern renewable energy technologies, in particular solar and wind energy, has been accelerating in a number of Arab countries over the tracking period. This is an encouraging result that is dented, however, by the very low share of renewables in the region's energy mix. Gains remain small in absolute terms, implying outside countries with high rates of biomass use (predominantly Arab LDCs), renewables continue to contribute a negligible share of the region's energy needs and increases in modern renewable energy use are insufficient to bring the Arab region close to its 2030 target. This means current progress must be accompanied by much accelerated policy action in the coming years in order to ensure Arab countries can take advantage of their largely untapped modern renewable energy resources and to implement climate action.
- **Key deficit countries.** Very few Arab countries rely on renewable energy for a substantial share of their final energy consumption. Only in Mauritania, Morocco, the State of Palestine,

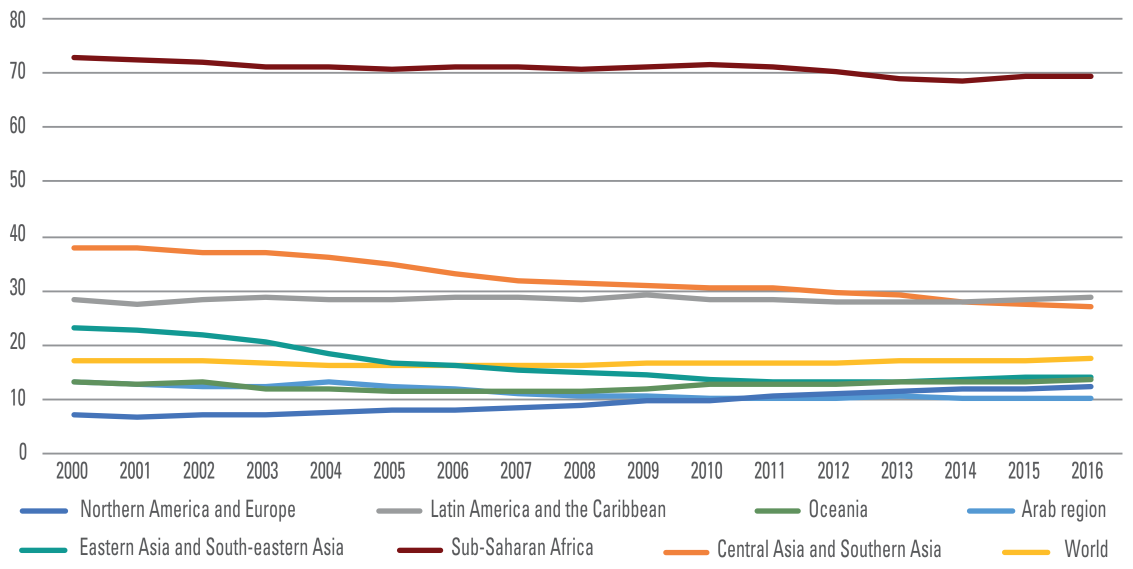
the Sudan and Tunisia does renewable energy contribute a substantial share—above 10 percent —to the national energy mix, and only with solid biofuel—in many cases providing inferior access to energy compared with modern liquid and renewable energy sources and electricity—retaining an overwhelming share in all of these countries' renewable energy consumption. Nine Arab countries, including all GCC countries, consumed no or negligible amounts of renewables, basing their energy mix virtually entirely on fossil fuels.

- **Consumption by final sector.** The residential sector remains the most dominant end user of renewable energy. In 2016, it accounted for over 80 percent of total renewable energy consumption, owing to the large proportion of solid biofuel used for cooking. Only 18 percent of the Arab region's renewable energy consumption is accounted for by electricity generation, with virtually no use of renewable energy in the transport sector.
- **Off-grid electrification.** Distributed electricity generation using renewable energy technologies have grown quickly in the Arab region owing to their large contribution to off-grid electrification. With much of the Arab region's remaining access deficit being concentrated in rural areas, off-grid options such as mini grids and self-generation have become a lifeline for many rural communities that are too scattered or remote to be economically connected to the national grid. The fast growth in solar-powered stand-alone systems, both for electricity generation and water-heating, in Lebanon, the State of Palestine and Yemen further illustrates the vast potential for technology to help restore secure energy access in conflict-affected settings and countries with pre-existing shortcomings in their utility sectors.

Are we on track?

The share of renewable energy has been plateauing at around 10.2 percent of the Arab region's total final energy consumption since 2010, following a long-term trend of decline. Over the tracking period 2014–2016[1], renewable energy as a share of TFEC again declined by 11 percent, driven primarily by declining consumption shares in the State of Palestine, the Sudan, the Syrian

Figure 38. Renewable energy share in total final energy consumption (percent), 2000–2016



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; (accessed April 2019).

Arab Republic and Tunisia. This trajectory, which is contrary to the world trend but similar to consumption patterns found in South and East Asia, largely reflects the move away from (mostly traditional) solid biofuels towards higher quality fuel and electricity.

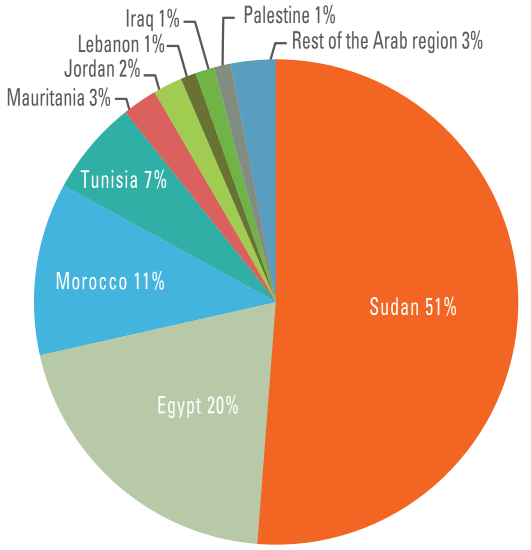
As of 2016, renewable energy accounted for around 10 percent of the Arab region's energy mix, the lowest share in any of the world's regions. A handful of countries account for virtually all of the region's renewable energy consumption, leaving substantial scope for further uptake, given the region's plentiful renewable energy resources.

Solid biofuel continues to dominate regional renewable energy consumption

Solid biofuels continue to account for the largest share of renewable energy consumed in the Arab region—around 81 percent of total renewable energy consumption. Three countries—Egypt, Morocco and the Sudan—account for over 85 percent of the region's total consumption of solid biofuel; the Sudan alone consumes 59 percent. This high share of solid biofuel in the region's total renewable energy consumption reflects the limited role modern renewable energy technologies such as wind and solar power have until recently played in the Arab region, as well as high access rates to more efficient, non-renewable liquid fuels and electricity in a majority of Arab countries.

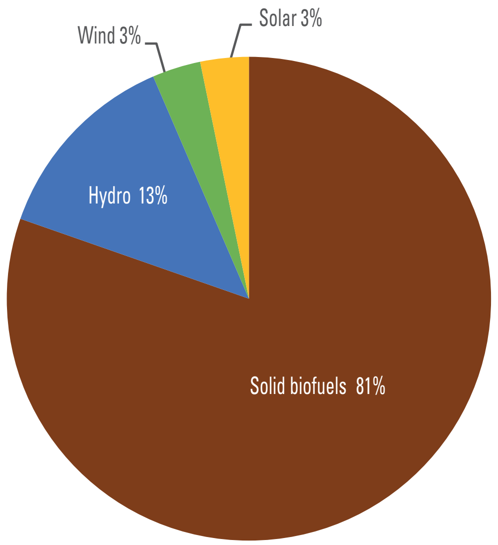
Solid biofuel use in the Arab region is inefficient. Much of the Arab region's solid biofuel use is traditional, largely for use in cooking, heating and some lighting, with low levels of efficiency and high levels of associated indoor air pollution. Women and children are disproportionally affected by lack of access to modern energy, through higher exposure to indoor air pollution, lack of access to modern health facilities, and the impact of their time spent on fuel collection on their chances of accessing education and paid work opportunities.[2] Traditional biomass use can be sustainable where sufficient forest resources exist, but can also result in environmental degradation, in particular deforestation, that has

Figure 39. Total Arab renewable energy consumption by country, 2016



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018 (accessed April 2019).

Figure 40. Renewable energy consumption by type of fuel in the Arab region, 2016



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; (accessed April 2019).

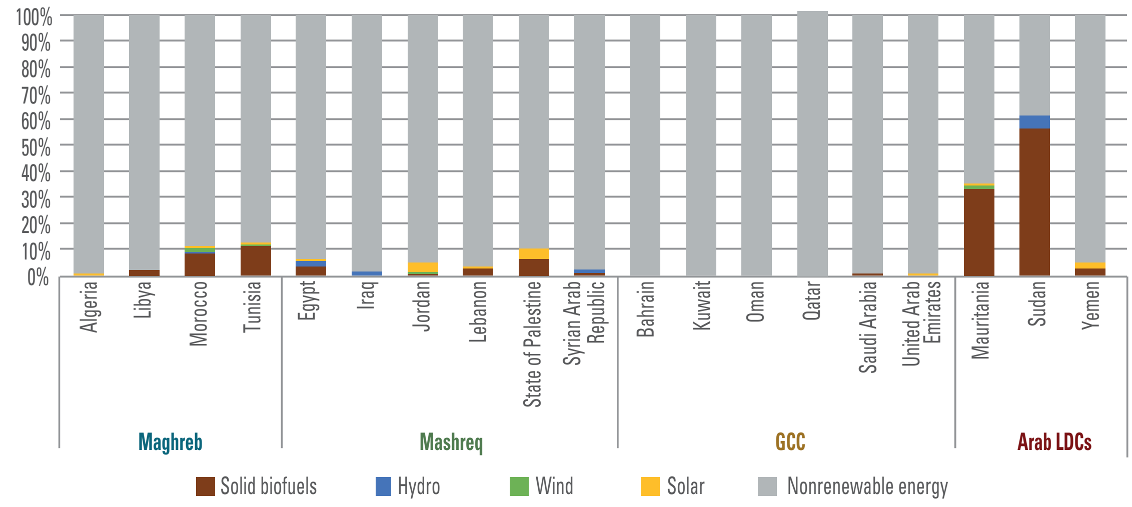
been threatening the basis of rural community life, for instance in Morocco and Yemen.[3] In some cases, this can lead to intensified social conflict over land and forest ownership, feeding further into political conflict and instability.[4] Prospects for additional environmental problems related to climate change, including water scarcity and more extreme weather conditions, are likely to exacerbate the precarious living conditions many rural communities already face today.[5] Some industrial biomass use exists in Egypt and the Sudan, based mainly on bagasse in the sugar-processing industry.[6]

The contribution of renewable energy to the region's energy mix remains marginal

Few Arab countries rely on renewable energy for a substantial share of their final energy consumption. Only in Mauritania, Morocco, the State of Palestine, the Sudan and Tunisia does renewable energy contribute to a substantial share—above 10 percent —to the national energy mix, and only with solid biofuel retaining an over-riding share in all of these countries' renewable energy consumption. Nine Arab countries—including all GCC countries—consumed no or negligible amounts of renewables, basing their energy mix virtually entirely on fossil fuels. In 2016, three countries—Egypt, Morocco and the Sudan—accounted for around 83 percent of the region's total renewable energy consumption, with solid biofuels accounting for a large portion of this consumption.

Excluding solid biofuel consumption, the region's countries with the highest share of renewable energy technologies in their final energy mix are Egypt, Jordan, Morocco, the State of Palestine, the Sudan and Yemen (Figure 42). Hydropower remains the most dominant technology in countries with hydro-resources, in particular Egypt, Iraq, the Sudan and the Syrian Arab Republic. Only in Morocco is wind energy more important today than hydropower. Solar and wind energy have increased their use in recent years, with the highest shares in TFEC in Jordan, the State of Palestine and Yemen. Iraq, too, has seen an uptake of solar energy over the tracking period, but limited capacity for data collection over the period 2014–2017 means that official data do not reflect this use, which remains largely undocumented.[7]

Figure 41. Share of individual renewable energy sources in total final energy consumption, by Arab region country, 2016



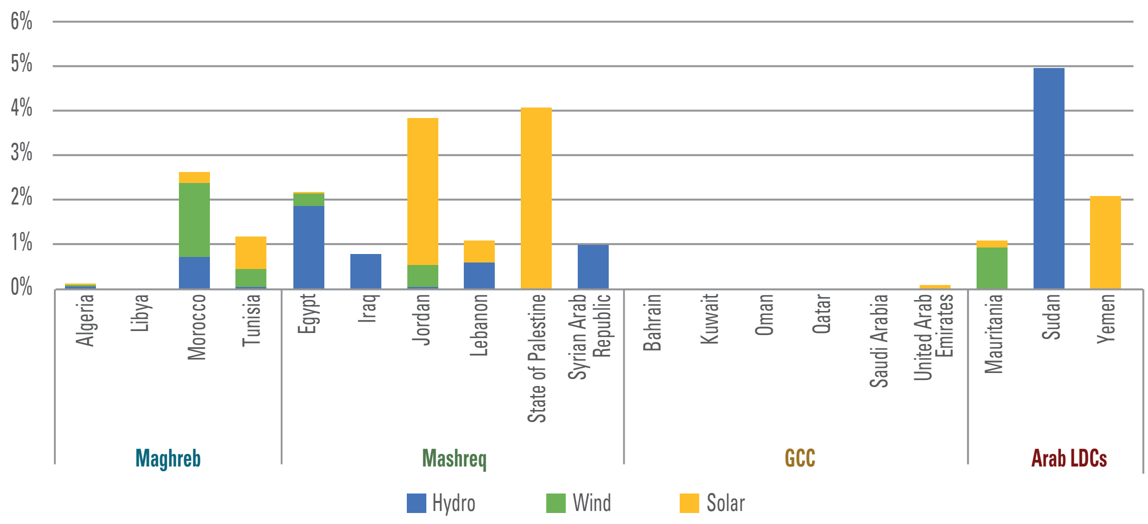
Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; (accessed April 2019).

With around 13 percent of total renewable energy consumption, hydropower remains the most important renewable energy source in the Arab region after solid biofuel. Four countries—Egypt, Iraq, Morocco and the Sudan—account for almost 90 percent of the region's hydropower consumption, reflecting the very high degree of resources concentration in these countries. In Iraq, political instability has hindered maintenance of many hydropower facilities, resulting in increased dependence on natural gas-fired power plants relative to hydropower.[8] With available sites largely being in use, however, further growth potential for hydropower is limited.

Solar energy is the next largest renewable energy source in the Arab region, accounting for some 3 percent of the region's total renewable energy consumption. It is also the fastest growing renewable energy source in power generation, according to International Renewable Energy Agency (IRENA) data.[9] Solar resources are generally excellent throughout the region,[10] though deployment has so far fallen short of the technology's region-wide potential. Four countries—Jordan, the State of Palestine, Tunisia and Yemen—account for over three-quarters of the entire Arab region's consumption of solar power. The most recent advent of solar power in the Arab region reflects much increased policy focus on promoting alternative energy, combined with the rapidly falling cost of solar power—both in the on- and off-grid value segments. The fast adoption of solar power in Lebanon, State of Palestine and Yemen also highlights the vast potential of stand-alone solar systems, in addition to larger scale utility-size projects, to contribute significantly to energy provision. This includes the increasing importance of off-grid solar power as a long-term solution to rural populations otherwise cut off from main-grid electricity access; and the flexible use of rooftop solar systems in countries with unstable grid-based supply, including conflict-affected countries.

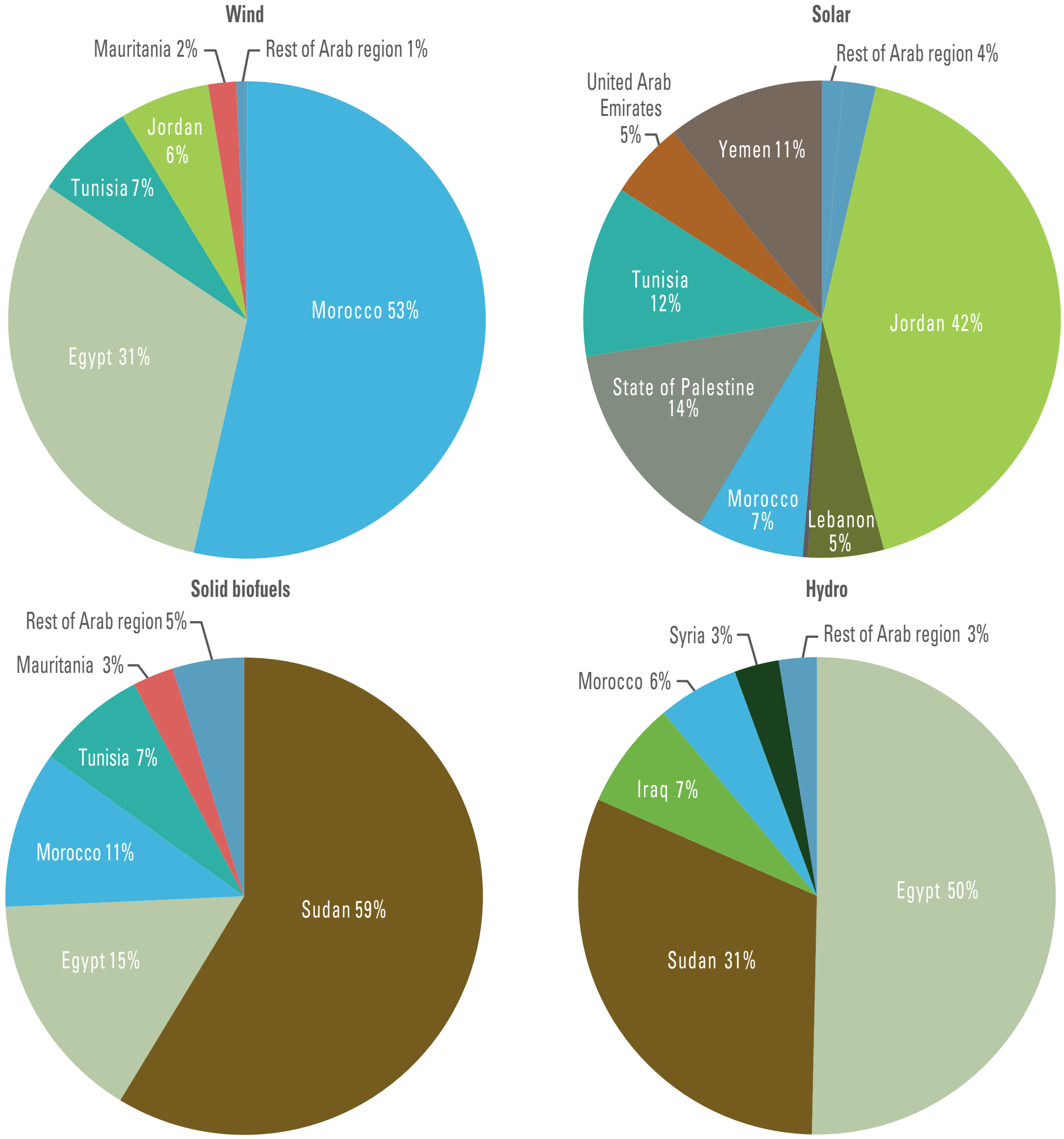
Wind energy accounts for around 3 percent of total regional renewable energy consumption, although consumption has been growing rapidly. Like water resources, large-scale wind resources are unequally distributed throughout the region, although site potential remains underdeveloped in many countries. A number of low-cost wind projects in countries such as Egypt, Jordan, Morocco and Tunisia have, in recent years,

Figure 42. Renewable energy share in total final energy consumption by technology (excluding solid biofuel), 2016



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018.

Figure 43. Renewable energy consumption by fuel and country



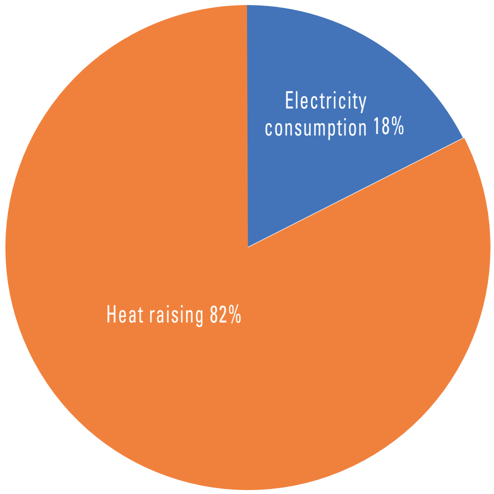
Source: Authors' calculations based on International Energy Agency, 2018; United Nations Statistics Division, 2018 (accessed April 2019).

increased the relative attention wind power has received vis-à-vis solar power, with potential for a further expansion in wind power consumption in the region until 2030. In 2016, the single largest wind energy consumer was Morocco, which alone accounted for over half the region's consumption, followed by Egypt, Tunisia and Jordan. Combined, these four countries account for over 95 percent of the region's consumption of wind energy.

The dominant use of renewable energy remains in heat raising …

Owing to the high share of solid biofuel for use in cooking and heating in the Arab region, the residential sector remains the most dominant end-user of renewable energy. In 2016, heat raising accounted for over 80 percent of total

Figure 44. Final consumption of renewable energy by end-use sector, 2016



Source: Authors' calculations based on International Energy Agency, 2018; United Nations Statistics Division, 2018 (accessed April 2019).

renewable energy consumption, owing to the large proportion of solid biofuel used for cooking. Egypt, Mauritania, Morocco, the Sudan and Tunisia account for over 90 percent of renewables use in heat raising owing to the continuingly large role of biomass used for heating. The dominance of these countries' consumption patterns in the regional renewable energy mix also reflects the marginal role of renewable energy—solid biofuel or else —elsewhere in the region, implying total regional consumption patterns reflect in reality only a handful of countries' consumption trends.

Other renewable energy technologies for use in heat are growing but remain small in comparison with traditional uses of biomass. Increasingly, solar water heaters (SWHs) add to the use of renewable energy, at small but growing rates with applications ranging from the Maghreb countries (starting in Tunisia), to the Mashreq and Arab LDCs. Other, though less widespread technologies include biomass-brick boilers and more recently, solar-powered air-water heat pumps, which are used in parts of the Mashreq.[11]

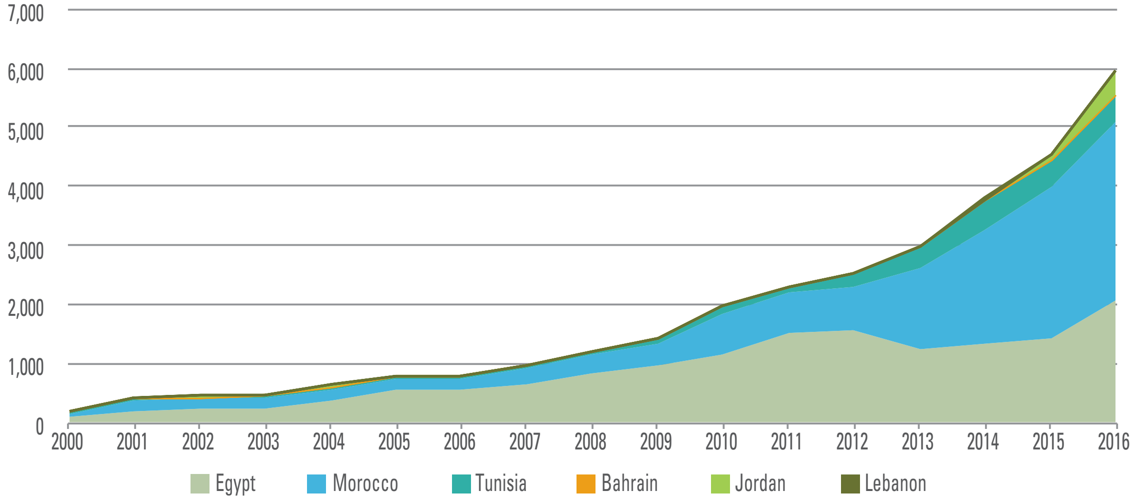
The potential for renewable energy—in particular solar energy—to contribute a greater share to heat generation in the future is large. Jordan illustrates this potential. In 2016, the total number of installed SWHs funded by civil society institutions reached 3,500 systems. This number almost tripled in 2017–2018, reaching 16,000 installed SWHs and saving around 53 GWh of energy. By 2020, Jordan's solar water heating market is expected to save 82.5 GWh of energy and avoid around 50 kt of CO_2 emissions through 25,000 installed SWHs with the target to increase the dissemination rate of SWHs in the residential sector to reach 25 percent by 2020.[12] Egypt has been successfully encouraging the increased use of SWHs through its EGYSOL project, which incentivizes hotels and resorts in the Red Sea and the Sinai through a subsidy to the initial cost of equipment and maintenance for a period of four years.[13] In the State of Palestine, 56 percent of households used SWHs in 2017.[14] In Lebanon, by the end of 2016, a total of 550,000 m^2 of SWHs had been installed and were operational, saving 364 GWh of energy and 237 kt of CO_2 per year. The target for Lebanon is to reach 1,054,000 m^2 by 2020 and until 2016, the yearly target had been met. This is partly thanks to a mix of grants and subsidized loans for SWHs in Lebanon facilitated by the Central Bank and commercial banks.[15] Solar heat also has potential for industrial use, with Oman having one of the world's largest concentrated solar thermal (CST) plants.[16]

… though the fastest growth occurs in electricity generation

Only 18 percent of the Arab region's renewable energy consumption is accounted for by electricity generation. The three largest regional consumers of renewable energy for electricity generation in 2016—Egypt, Morocco and the Sudan—together account for over 80 percent of the region's total. Hydropower remains an important source of electricity supply in all three countries, although wind and solar become increasingly important alternative resources for electricity generation, in particular in Egypt and Morocco.

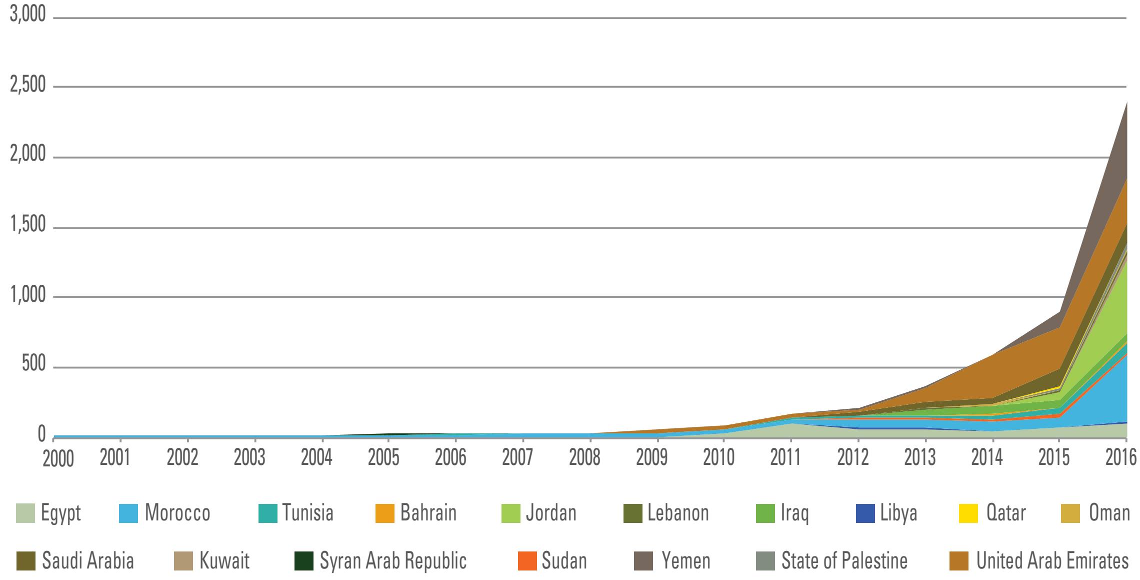
The fastest growth in electricity generation from renewable energy sources by contrast has been seen in solar and wind technologies. Installed electricity generation capacity increased by an average of 9 percent per year for wind energy, and 54 percent for solar energy between 2014 and 2016, according to IRENA data (Figure and Figure). The time period since 2015 in particular has seen a fast rise across countries in electricity consumption from solar energy. This is a highly encouraging development that suggests further growth ahead in subsequent years. Jordan has seen the fastest growth in deployment in the electricity sector, driven by solar PV and wind power.[17]

Figure 45. Electricity generation from wind energy in the Arab region (GWh), 2000–2016



Source: International Renewable Energy Agency, 2018b.

Figure 46. Electricity generation from solar energy in the Arab region (GWh), 2000–2016



Source: International Renewable Energy Agency, 2018b.

The years 2014–2017 saw significant cost reductions for solar power utility-size projects, driven by Arab countries. GCC members Saudi Arabia and the United Arab Emirates have set consecutive world low-price records for utility scale solar PV and CSP in 2016 and 2017, making solar PV cost-competitive with every other fuel on the market.[18] Wind parks in Egypt, Morocco and Jordan have been producing highly competitively priced electricity for several years now.[19] Increased use of distributed generation, for use by both off- and on-grid market segments, adds significantly to deployment in recent years. This experience sends important market signals to other countries thinking about boosting the share of these technologies and underlines that the cost of modern renewable energy technologies itself is no longer an appropriate justification for the lack of deployment of renewable energy in the Arab region.

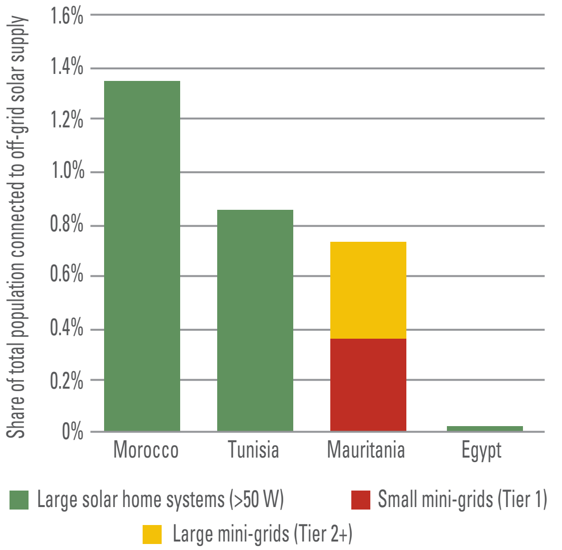
Effective policy design to remove market barriers and encourage private investment has been key to help drive up the deployment of solar and wind power in the Arab region. This includes an attractive investment climate for utility-scale solutions and attractive financing rates, such as in the GCC.[20] Countries such as Egypt and Jordan have also boosted incentives for individual user groups through associated feed-in tariff regulations, as well as through continued electricity tariff reform that make renewable energy increasingly competitive from an end-user perspective.[21] Morocco recently granted small private developers of renewable energy the right to connect their projects to the medium voltage grid, giving them access, albeit with some restrictions, to end users, providing more incentives for small businesses and households to install rooftop systems.[22]

On the other hand, de-risking renewable energy investment (DREI) policies in Lebanon and Tunisia are also assisting policymakers to cost-effectively promote and scale-up private sector investment in renewable energy. The DREI framework systematically identifies the barriers and associated risks which can hold back private sector investment in renewable energy and then assists policymakers to put in place packages of targeted public interventions to address these risks.[23] The end result is a reduction in the levelized cost of energy from utility-scale solar PV and wind energy projects.

Distributed generation is growing rapidly …

Distributed electricity generation using renewable energy technologies has grown quickly in the Arab region owing to their large contribution to off-grid electrification. With much of the Arab region's remaining access deficit being concentrated in rural areas, off-grid options such as mini grids and self-generation have become a lifeline for many rural communities that are too scattered or remote to be economically connected to the national grid. The rapidly falling cost of stand-alone solar power systems vis-à-vis diesel-powered generators has further helped create economic and environmentally sustainable options for rural communities to access electricity for lighting, water heating, and other small-scale uses of electricity.[24] Egypt, Mauritania, Morocco and Tunisia have successfully been using off-grid solar systems for rural communities (Figure 47), while Libya and Yemen also report increased use.[25]

Figure 47. Arab countries with highest off-grid access rate (Tier 1 and above)



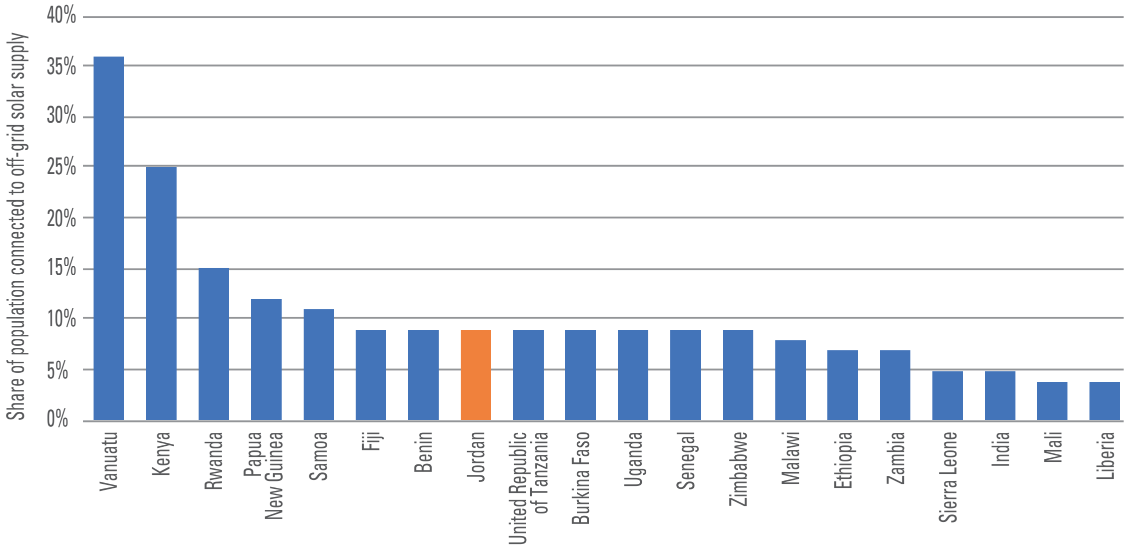
Source: International Renewable Energy Agency, 2019a.

The tracking period has also shown significant growth in stand-alone solar systems to complement grid-access in a number of Arab countries. In 2016, Jordan, Lebanon, the State of Palestine and Yemen combined accounted for over two-thirds of the Arab region's total solar energy consumption, with decentralized applications accounting for a large (virtually the entire)—share of total solar energy consumption. Although still comparably expensive, and therefore affordable primarily to middle-income households and above, the technology offers significant benefits in countries with frequent service disruptions as a backup solution in direct competition with diesel generators. In addition, solar-powered mini-grids have gained increased traction in a number of different settings, from Egypt's comparably large Masdar Siwa Project (2015), to various small solar and hybrid grids in the state of Palestine, to the use of mini-grids on islands, as in the United Arab Emirates islands of Al Hayl and Al Jarnain (both since 2015).[26]

Jordan's case highlights the potential of dedicated government policy in successfully promoting use of decentralized solar-based systems. The Jordanian Government has been actively promoting solar rooftop systems, through incentives such as a net-metering scheme, wheeling regulations and a tax-incentive regime.[27] Jordan's dependence on imported fossil fuels for virtually all of its energy needs has significantly altered the discourse on renewable energy and encouraged policies promoting alternative technologies among household users as well as businesses and industries. Jordan was among the world's top 20 countries with the highest share of small-scale solar lighting systems in 2017, with over 9 percent of the population using solar lights (Figure 48) and more than 200,000 units installed between 2014 and 2017, according to IRENA data.[28]

In Lebanon, the Government also played an active role in promoting decentralized renewable energy applications. In 2010, it launched the National Energy Efficiency and Renewable Energy Action (NEEREA) through the Central Bank of Lebanon. NEEREA is a national low-interest financing mechanism dedicated to the financing of green energy projects in Lebanon. By the end of 2017, NEEREA funded 533 solar PV projects valued at USD 42 million, totalling 22.5 MW peak[29] or 64 percent of the total solar PV capacity installed in Lebanon.[30] This emphasizes the positive and disruptive impact such policies can have on decentralized renewable energy growth.

Figure 48. Top 20 countries (globally) with the highest share of solar lighting systems (below Tier 1) in 2017

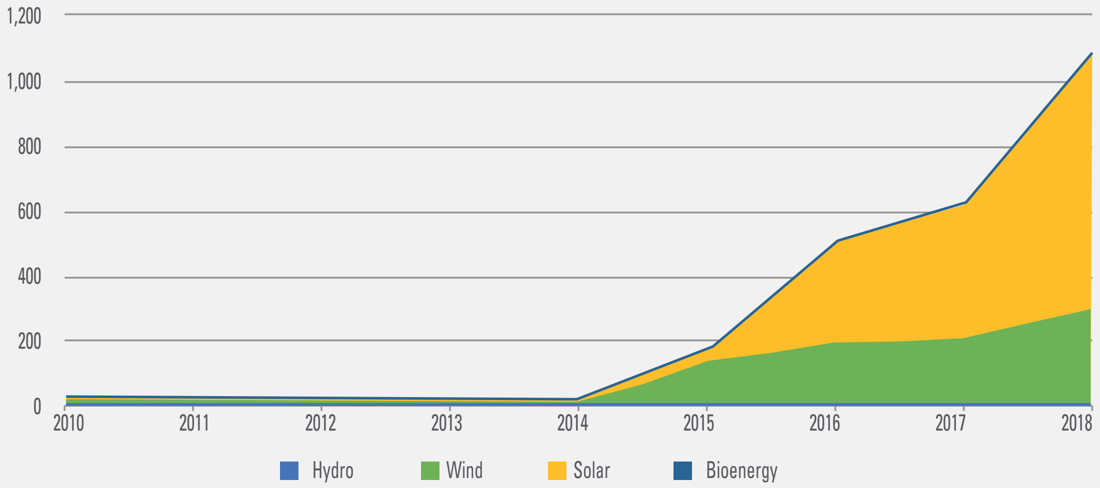


Source: International Renewable Energy Agency, 2019a.
Note: Arab region countries in orange

Box 12. Increasing use of distributed solar systems in Jordan

Jordan has seen rapid growth in distributed solar energy consumption in recent years, turning the country into the Arab region's largest consumer of solar energy in 2016.[a] The fast adoption of solar technology by households and small businesses follows both general policy aimed at increasing the use of renewable energy in Jordan and specific legislation aimed at incentivizing private users to invest in self-generation technology. Jordan has created these incentives with the aim of diversifying its energy mix and reducing reliance on costly energy imports, which supply over 95 percent of its domestic energy needs. While more than 95 percent of Jordan's TFEC rests on fossil fuels, Jordan's electricity generation capacity from renewable energy grew more than 200 percent per year over the tracking period 2014–2017, with further fast growth in 2017-2018.[b] Most of this growth has come on the back of increased solar power generation capacity,[c] with distributed electricity systems contributing significantly.

Evolution of renewables-based electricity generation capacity in Jordan (MW), 2010–2018



Source: International Renewable Energy Agency, 2019a.

In 2015, the Government launched the National Energy Strategy (NES) 2015-2025 under Jordan Vision 2025, which aims, inter alia, to raise the share of national energy consumption met from local energy supply from 2 percent to 40 percent by 2025, with an 11 percent renewable energy target for 2025.[d] The NES follows the 2012 Renewable Energy and Energy Efficiency Law (REEL), which opened up the market for private energy generation linked to the national grid.[e]

In addition, Jordan introduced an electricity wheeling mechanism through a directive issued in 2015 pursuant to Article 7/B/3 and Article 9/B from the General Electricity Law No. 64 of 2002. This mechanism allows private users to install a renewable energy system, for the purpose, as well as selling surplus electricity to the grid. Jordan had previously launched the region's first feed in tariff) system in December 2012, which provides the basis for feed-in systems.[f]

Specifically, to support small-scale, rooftop electricity generation, Jordan introduced a series of measures aimed at incentivizing private solar and other renewables-based systems:

- **A net-metering scheme for self-generation using renewable energy systems.** Jordan's 2012 Directive Governing the Sale of Electrical Energy Generated from Renewable Energy Systems related to Art. 10/B of REEL No. 13 allows consumers to install, use and connect renewable energy systems based on solar, wind, bio-energy, geothermal, and small hydro installations to the grid with fixed purchase prices for excess power.[g]

- **A tax-incentive regime.** In order to make green technology financially more attractive, Jordan has, since 2013, exempted systems equipment for renewable energy sources and energy efficiency from customs duties and sales tax, with further legislation (By-law No. 13 of 2015) since 2015 reinforcing this decision.[h]
- **Compulsory solar water heater installation.** The same by-law (Art 10) has made it compulsory since 2013 to use SWH systems for buildings with an area of 250 m^2 or more; apartments with an area of 150 m^2 or more; offices with an area of 100 m^2 or more, and in commercial buildings.[i]

In addition to private households, the Jordanian Government also opened small solar plants at the Syrian refugee camps of Zaatari and Azraq in 2017 that provide several tens of thousands of people with free and clean electricity.[j] According to the Ministry of Energy and Mineral Resources, the total installed capacity in operation in December 2018 was 360 MW from distributed solar systems (net-metering and wheeling).[k]

Source:
[a] ESCWA, 2019b
[b] CAGR calculated based on International Renewable Energy Agency, 2019b.
[c] International Renewable Energy Agency, 2019b.
[d] ESCWA, 2018c.
[e] ESCWA, 2019b.
[f] ESCWA, 2019b.
[g] ESCWA, 2019b; 2018c.
[h] ESCWA, 2018c.
[i] ESCWA, 2018c.
[j] Taha, 2018.
[k] ESCWA, 2019b.

…with high relevance for conflict-affected countries as well

The value of distributed generation is particularly high in conflict-affected countries and countries with frequent disruptions to electricity services. Widespread destruction of energy infrastructure in Iraq and Yemen has increased the attractiveness of solar rooftop panels. In the State of Palestine, self-generation using solar panels also holds strong strategic value, since it could eventually help reduce dependence on imported electricity from Israel. Unlike grid-based solar power, rooftop solar PV in the State of Palestine is not contingent on progress towards sector creditworthiness and the capacity of the State of Palestine's national grid, thereby circumventing challenges in deploying centralized utility-size solar projects in the country.[31] A 2019 study by the World Bank suggests Gaza could meet some 6 percent and the West Bank 20–30percent of its energy needs from solar energy by 2030.[32]

Decentralized solar water heaters and power systems have also begun to play an increasing role in supplying energy to the Arab region's large number of refugees. Jordan, which hosts some 660,000 Syrian refugees,[33] has implemented several solar-driven projects in response to the significant additional cost to host communities of refugee populations. The Jordanian Government installed PV systems on school rooftops in communities that host more than 5 percent of the Syrian refugees to help cover part of the increased energy demand at public schools . In addition, it installed some 3,564 SWH systems which benefited shelters rented by refugee families, helping reduce utility bills by 28 percent. In addition, a 13 MW solar power plant was completed in Za'atari camp in November 2017, helping increase electricity hours in the camp from 8 to 14 hours per day.[34] In addition, solar water pumps have been in use in agriculture and public water supply in a number of Arab countries, including Algeria, Egypt, Iraq, Lebanon, Libya, Mauritania, Morocco, Oman, the Sudan, the Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen.[35]

Off-grid electrification using solar systems benefits from a range of different financing models for the dissemination of the technology. An important driver to help demonstrate the technology's potential have been national and international development programmes, such as Lebanon's Country Energy Efficiency and Renewable Energy Demonstration for the Recovery of Lebanon (CEDRO)[36] and UN-linked projects in Gaza.[37] In more recent years, private markets have become increasingly important, as solar stand-alone systems offer significant cost-saving potential to users that have rendered solar panels a marketable product even in most adverse environments, for instance in Yemen.[38]

Box 13. Off-grid electricity access using solar technology in Mauritania

Mauritania has made substantial progress in increasing generation capacity in recent years, with substantial solar and wind capacity in its electricity generation mix and additional potential to export gas-based generation. However, this generation capacity has mostly benefited the urban population, which has access to the country's electricity grid.[1] Around 50 percent of Mauritania's population lives in rural areas in a scarcely populated country with many remote settlements.[2] Connecting rural communities to the national grid is in many cases prohibitively expensive, including, in many cases, the construction of mini-grids.[3] Mauritania's rural electrification rate in 2017 stood at 0 percent.[4] This makes decentralized options clearly a priority area to connect rural communities to the electricity grid.

Renewable energy applications are new to Mauritania's off-grid electrification, with diesel generators being traditionally used by rural households and mining industries.[5] Costs to companies providing diesel-based off-grid solutions and to households differ substantially between service providers and can be very high. Electricity produced on mini-grids was estimated in 2014 at an average of USD 0.54/kWh, while off-grid customers paid the equivalent of social rates, between USD 10.6 cents to USD 17.5 cents/kWh, depending on whether clients were served by Mauritania's national utility SOMELEC or delegated service providers. By contrast, the average world-level price for hybrid diesel-renewable based on solar PV or wind mini-grids was at the time estimated to be 0.4 USD/kWh without subsidies,[6] prices for which would have fallen further since then. These numbers highlight the substantial potential for renewable energy-based and hybrid off-grid installations in providing access to electricity to Mauritania's rural populations in the future.

In 2014/2015, a wind power mini-grid project and a grid-connected hybrid solar, wind and hydro project were approved for funding by the IRENA-ADFD (Abu Dhabi Fund for Development) for Mauritania. 50 percent of the project's estimated cost of USD 22 million was provided by ADFD, the other 50 percent by the Mauritanian Government. The multi-sectoral projects established access to clean energy to 169 villages. The wind energy mini-grid project was designed not only to produce electricity for household use, but also for water desalination and refrigeration needs in the conservation of fishery products.[7]

More recently, the World Bank's Lighting Africa initiative through its Regional Off-Grid Electrification Project (ROGEP) provides Mauritania, along with other West African countries, with support to foster sustainable and scalable off-grid electrification programmes.[8] The World Bank has further been exploring opportunities to include Mauritania in regional programmes such as the Economic Community of West African States (ECOWAS) Regional Electricity Access Project.[9]

Source:
[a] World Bank, 2018b.
[b] World Bank, 2019b.
[c] World Bank, 2018b; African Development Bank, 2016; United Nations Development Programme, undated c
[d] World Bank, 2019d.
[e] International Renewable Energy Agency, 2015
[f] United Nations Development Programme, undated c.
[g] International Renewable Energy Agency, 2015
[h] World Bank, 2019a.
[i] World Bank, 2018b.

Renewables have not yet entered the region's transport sector

Renewable energy is not currently used in the transport sector in the Arab region. Small rates of indirect consumption result from the use of electricity generated from renewable energy in electrified train networks, with negligible amounts in Algeria, Egypt, Morocco and Tunisia. The United Arab Emirates uses a very small amount of biodiesel produced from waste vegetable oils.[39] A number of countries have, however, begun or plan to switch at least part of the vehicle stock to natural gas and electricity. Renewable energy could hence enter the energy mix for transport through its contribution to electricity generation, which then powers vehicles such as taxis, public buses and private cars. Egypt and Jordan, for instance, were, at the time of writing, studying the electrification of part of their vehicle stock.[40] In the GCC, the United Arab Emirates has already been building electric charging stations for cars and provides incentives to users buying electric vehicles.[41] Lebanon exempted electric vehicles from customs altogether and reduced customs from 50 percent to 20 percent for hybrid vehicles for private use and to 10 percent for public use.[42] In addition, for both hybrids and electric vehicles, owners are exempted from paying registration and the first annual tag fees.[43] Saudi Arabia has invested substantially in the sector, suggesting part of the market for renewable energy could come from the electrified transport sector in the future.[44]

Policy implications

Renewable energy continues to be used far below its potential in the Arab region. Modern renewable energy technologies, in particular solar energy, hold vast potential to address a whole range of energy needs in the Arab region. Negative growth in renewable energy use as a share of TFEC over the tracking period reflects decreased use of solid biofuel, much of which is traditional and non-sustainable, but also the continuing small share of modern renewable energy technologies that so far fail to compensate for the fall in biomass consumption. Progress here needs to speed up substantially across countries through the opening up of market opportunities and the removal of barriers to the entry of renewables to the national energy mix.

Rapidly falling costs for solar and wind technologies, both at utility scale and in the off-grid sector, increase the argument in favour of increasing the uptake of more renewable energy. The increasing cost-competitiveness of modern renewables for electricity and heat generation is an important message emerging from past years in the Arab region. Arab countries have set subsequent world record low-bid prices for utility-size solar PV and solar CSP projects in 2016 and 2017, respectively,[45] indicating the vast potential of these technologies to compete on the basis of economics alone. This is also increasingly true in the case of off-grid applications that compete with diesel generators.

In addition to utility-scale deployment, the off-grid segment offers significant opportunities for market growth of solar power in countries with incomplete electricity access. Solar off-grid systems reduce reliance on more expensive diesel, providing secure electricity access to those who so far been left behind. Examples include rural electrification initiatives in countries such as Mauritania, Morocco and Yemen. Promoting the use of solar power for rural electrification is a task for policymakers that includes the preparation of markets through the provision of microfinance solutions and product quality controls in addition to more systematic information management.

The highly encouraging developments of 2014–2017 in the use of solar stand-alone systems suggest far greater policy focus should be turned to distributed generation in its own right. Countries such as Jordan and Lebanon demonstrated over the tracking period the enormous potential for distributed generation and consumption of solar power, even where grid access is available. The decentralized solar PV market in Lebanon grew by a factor of eight from 2014 to 2017.[46] Currently, self-generation remains most attractive where grid-based access is irregular and where solar rooftop panels therefore offer a cost-competitive option to expensive backup generators. In the future, much more market share could be taken up by distributed generation across different Arab countries, if consumers are provided with the right financial incentives. Legislation such as in Egypt, Jordan and Morocco demonstrates what some of the respective national legislative frameworks could look like.

Stand-alone solar power systems also hold significant potential to help restore electricity access in conflict-affected countries. The State of Palestine and Yemen demonstrate the enormous market potential for solar self-generation, stand-alone systems that have proved to be cost-effective and practical in situations where central states are defunct and/or central grids are working with limited capacity. This is a most encouraging recent development, with substantial potential to help build more resilient societies and economies in conflict-torn countries in dire need to re-establish minimal public services and living conditions, and to reinvigorate basic business activity. Supporting the adoption of stand-alone solar power systems in public buildings such as schools and medical facilities, in SMEs and households, should hence take priority in developing project financing and policy design aimed at restoring peace and stability in a number of Arab countries.

Effective legislation and a business-friendly environment have been an important driving force behind recent success in utility-scale deployment of solar and wind projects in the Arab region. At the heart of these success stories were often well-designed regulatory frameworks aimed to attract private investment through competitive bidding mechanisms under Independent Power Producers (IPPs). Closely tied to these frameworks is an overall national legislation that reduces risks and advances the financial viability of investment in the sector and improves the business climate for private sector investment. This highlights the importance of policy in setting the right conditions for renewable energy.

Affordability of solar off-grid systems remains an issue for poor households, making effective policies to encourage access to credit facilities essential to increasing the uptake of distributed solutions. This means that, despite important progress in the use of off-grid systems in countries including Jordan, the State of Palestine and Yemen, markets still fail in making these technologies mass products accessible to low- and lower-middle income households.[47] Effective policy design to help markets deploy off-grid solar systems in greater numbers will need to include suitable financing mechanisms including at the micro-level and facilities that target households with no formal access to banking. National governments, as well as international lending bodies and development aid donors, can all engage in the provision of suitable financing tools, most critically in microfinance.

Albeit counting toward the region's renewable energy consumption, the continued use of traditional solid biofuel, in particular in the Arab LDCs is not sustainable. The effects of inefficient biomass on households, women and children, and local environments is highly problematic and requires much greater policy action. Continued traditional biofuel use in the LDCs underlines the need for sustainable energy solutions for households that can include greater electrification through the expansion of grid-based and off-grid systems, the switch to more modern forms of solid—and gaseous—biofuel or, in some cases, the switch to non-renewable LPG for cooking. Arab LDCs need to be supported in this endeavour by the full range of national and international actors.

Harvesting the significant benefits of modern renewable energy requires far more dedicated policy design—and investment—than is currently the case. Arab countries' scores under ESMAP's RISE suggests substantial room for improvement at the regulatory and policy level.[48] While a number of Arab countries have adopted ambitious renewable energy targets, practical policy measures to achieve those targets are often still missing. At the same time, barriers to systematic deployment in the utility sector in many cases remain high, reflecting a sector that has yet to move on from a decade-long modus operandi that has focused on state-led, oil- and gas-based business. Arab LDCs are among those countries that could benefit most immediately from the rapidly improving economies of renewable energy technologies, both in the on- and off-grid market segment; so could many of the Arab middle-income countries, whose increasing energy needs require sustainable solutions beyond their current energy mix and utility business models. Renewable energy also offers the Arab region a tremendous opportunity to help reduce environmental pollution and to address climate change, the implications of which are expected to be severe (Chapter 4). This is a call for policymakers to engage much more proactively in energy policy design that takes up the enormous opportunities offered by renewable energy—today—not sometime in the future.

4. Sustainable Energy and Climate Change

SDG 13 asks governments to "take urgent action to combat climate change and its impacts", including by strengthening resilience and adaptive capacity to climate-related hazards and natural disasters in all countries; by integrating climate-change measures into national policies, strategies and planning; by improving education, awareness-raising and human and institutional capacity on climate-change mitigation and adaptation; and by implementing developed-country parties' commitment to the United Nations Framework Convention on Climate Change to mobilize substantial funds to support climate action across the globe, leaving no one behind.[1] This chapter explores the links between SDG 13 with progress in SDG 7, highlighting the close relationship between these two sustainable development goals and the need to better integrate them in future energy policy.

Main messages

- **Climate action and SDG 7.** Progress in sustainable energy and climate action is closely interlinked. The Arab region is highly vulnerable to future effects of climate change, whose effects threaten the livelihood of millions by impacting the availability of arable land, drinking water, through increased heat, and the more frequent occurrence of natural disasters. Decoupling economic growth and prosperity from energy use, by increasing the share of sustainable, clean energy sources and by increasing the efficiency and productivity of energy use as envisioned under SDG 7 is hence a key step to climate action under SDG 13. Combined, the two development goals also go hand in hand in facilitating progress across a range of other development goals, including the promotion of human health, gender equality and the creation of safe, resilient living spaces, in addition to the protection of natural resources on land and at sea.
- **Air pollution and the carbon footprint.** Climate action is urgently needed to respond to the Arab region's rapidly rising carbon footprint. While the region does not account for the largest part of global GHG emissions, it is the fastest growing emitter of GHG emissions worldwide. Arab countries also suffer from highly concerning levels of ambient air pollution. Annual mean exposure to fine particulate air pollution exceeds WHO guideline values in all Arab countries. WHO outdoor air-quality data also show the Arab region is one of the most particularly polluted regions in the world. These results are highly concerning from a climate perspective and from a public health point of view, highlighting the need for Arab countries to step up their efforts in climate action along with progress in SDG 7 as a matter of urgency in both the global and domestic interest.

- **Climate action in the water and electricity sector.** The intrinsic link between energy and water necessitates comprehensive action that addresses the two elements together. Several regional initiatives have confirmed this necessity and called for systemic change. While all these initiatives demonstrate the interest of regional governments in the energy–water nexus, a challenge remains to translate targets and intent into concrete and effective policy action. This includes a much more systematic integration of water and electricity policy, as well as the expansion of the use of available financing and technology options.
- **Aligning SDG 7, SDG 13 and NDCs.** National energy plans and NDCs need to be better aligned with SDG 7 and SDG 13. NDCs are at the heart of the Paris Agreement and the achievement of these long-term climate goals. Yet, less than half the Arab countries have undertaken a Voluntary National Review, highlighting the fact that, despite progress in energy access, few Arab region countries have tangibly advanced measurement of renewable energy and energy efficiency. Better alignment requires positive policy action in institution- and capacity-building, and coordination mechanisms: progress in SDG 7 and SDG 13 cannot happen in isolation from parallel political processes.

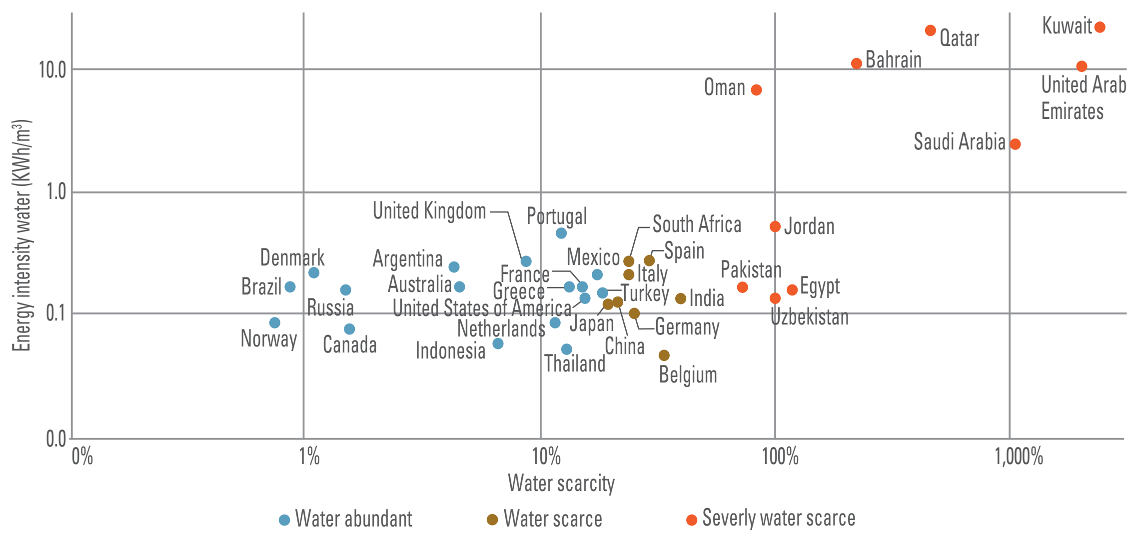
The Arab region is highly vulnerable to climate change

The Arab region is highly vulnerable to future effects of climate change. Characterized by its unique geography with some of the world's largest and harshest desert lands, the region has in the recent past experienced an intensification of already frequent droughts and further reduced rainfall threatens increased degradation and desertification. This threatens the livelihood of millions through the intense effect of climate change on the availability of arable land, drinking water, increased heat and the more frequent occurrence of natural disasters.[2] These prospects are all the more concerning in a region in which freshwater scarcity, population growth, urbanization, conflict and changing migration patterns already place increased pressures on human settlements and ecosystems.[3]

Increased water scarcity

Water is a scarce and fragile resource in the Arab region. Arab countries cover 10 percent

Figure 49. Water scarcity and energy intensity



Source: Napoli et al., 2016.

Box 14. Challenges to effective water governance in the Arab region

Increasing freshwater scarcity as a result of over-exploitation, in combination with limited renewable resources, is today one of the most significant environmental challenges in the Arab region, recognized as the top environmental issue in 19 out of the 22 Arab countries.[a]

While the water situation in the Arab region requires urgent attention and efficient management, ESCWA has noted that:

> "...several factors hinder Arab governments from making progress in water governance, including unclear or overlapping responsibilities, lack of funding, inefficient institutional mechanisms, lack of public awareness, centralized decision- making and inadequate enforcement structures. Inefficient water governance and inadequate management fail to address water sustainability... Most Arab countries deal with water management problems in silos and, therefore, water is often not considered as an integral part of economic and social sectors."[b]

The study provides further evidence from wastewater treatment. For example, in Jordan, 100 percent of treated municipal wastewater quantities are reused for irrigation, whereas, in the State of Palestine, 80 percent of treated municipal wastewater quantities are discharged to the sea. The study concludes that

> "Overall, most countries of the region have programmes for the treatment and reuse of wastewater, but they lack clear and efficient institutional guidelines on its regulation. Furthermore, treatment processes and infrastructure capacities in most Arab countries have resulted in an ineffective treatment of municipal wastewater, with the rates of treated wastewater varying from country to country."[c]

In addition to domestic management, the Arab region also lags behind in the effective and efficient management of cross-border freshwater resources. Some 66 percent of the region's freshwater resources cross the boundaries of one country or more, including in some cases water basins that are shared between Arab and non-Arab countries, and water basins located on or below occupied land such as part of the Jordan river basin.[d] Historically, advances in drilling and pumping technologies have produced opportunities to access shared groundwater resources in more remote geographical regions in order to meet growing demand, but this has also led to over-exploitation. ESCWA noted in 2018 that out of 21 Arab states sharing surface-water and/or groundwater resources with another country, only nine Arab states reported under SDG indicator 6.5.2. (transboundary cooperation over shared water basins).[e] ESCWA further noted that

> "The water scarce conditions of most Arab states and the perceived equivalence of water scarcity to water security in the region further inhibits the willingness to share information on shared water resources. These in addition to other reasons that include lack of studies on groundwater shared water resources and the lack of dedicated financial resources to shared water resources in terms of monitoring, reporting and management."[f]

UNDP separately observed that

> "The Arab region has a striking absence of inclusive, comprehensive international water agreements on its most significant transboundary watercourses."[g]

This result illustrates the immense challenges still governing the water sector in the Arab region, including the difficulty of effective and transparent water-sector policy.

Source:

[a] ESCWA, 2015b, p.7.
[b] ESCWA, 2015b, p. 13
[c] ESCWA, 2015b, p. 13
[d] ESCWA, 2015c, p. 32
[e] ESCWA, 2018e.
[f] ESCWA, 2018e, p. 7
[g] United Nations Development Programme, 2013c, p. 59

of the world's area but receive only about 2 percent of its average annual precipitation.[4] In 2015, the ESCWA/UNEP 2015 Arab Sustainable Development Report reported that 18 Arab countries fell below the water scarcity line of 1,000m^3/person/year.[5] By 2025, Iraq and possibly the Sudan were probably the only Arab countries with an average of above 1,000 m^3/person/year.[6] Water scarcity is a function of both population-density-driven water demand and available water supplies. Added strains on the Arab region's water sector include population growth, migration, changing consumption patterns, regional conflicts and governance.[7] Figure 49 highlights the high energy intensity of water supply against water scarcity in some Arab region countries.

Reduced precipitation combined with increasing temperatures has severe consequences on the region's agricultural sector and, hence, food security. Freshwater scarcity, rising temperatures, recurring periods of drought and land degradation and desertification are highly problematic for the region, where 40 percent of employment is related to agricultural activities.[8] World Bank projections from 2012 suggest climate change could result in an overall reduction in household income ranging from 7 percent in Tunisia to 24 percent in Yemen.[9]

Desalination forms an important part of many Arab countries' response to limited other water sources available. The Arab region accounts for more than half of the world's desalination capacity, with desalinated water contributing nearly all the water supply in many cities. While the overall share of desalinated water in the region's water supply remains small, it is expected to grow in the coming decades as a result of industrialization, accelerated urbanization, population growth and depletion of conventional water resources.[10] Countries such as Jordan and Tunisia desalinate brackish water at low cost and promote it for domestic use.[11]

Water-plant construction is centrally planned, but often separated from other planning functions and has focused on supply development. Only recently have some countries started taking a more integrated resource-planning approach. In 2011, for instance, Egypt, together with the World Bank, initiated an Integrated Water Resources Management project in the Nile Delta. The pilot scheme establishes the basis for scaling up investments to improve pollution control and to improve the ecosystem health of the Mediterranean Sea, helping build capacity for surface-water and groundwater management while improving rural sanitation and drainage water quality.[12]

Several GCC states have also begun to implement more integrated water-management programmes, in view of their high levels of water scarcity. In the United Arab Emirates, Abu Dhabi, for instance, implemented a high-level water-resource management strategy for 2014–2018 that involves stakeholders ranging from the agricultural sector, wastewater, desalination, amenities, groundwater and forestry, utilities and building and land planning.[13] This initiative was followed in 2018 by the United Arab Emirates Water Security Strategy 2036, which was initiated with the overall aim to help develop a comprehensive national strategy staged over 20 years, similarly to Abu Dhabi's previous strategy involving all relevant stakeholders from urban planning to agriculture.[14]

Rising temperatures

Modelling results suggest rising temperatures across the Arab region this century. The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) assessed the impact of climate change on the Arab region and found an increase in temperature of 1.2°C–1.9°C at mid-century and 1.5°C–2.3°C by end-century (see also Box 15 below).[15] The African Atlantic coastline and the central Arabian Gulf (Doha, Dubai, Manama) are particularly susceptible to heat stress, according to the RICCAR study.[16] Time-series analysis reveals that irrespective of seasons, warming was already clearly visible in the Arabian

Box 15. Modelling vulnerability to climate impacts in the Arab region

The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region assessed the impact of climate change on freshwater resources in the Arab region through an integrated regional initiative that identified the socioeconomic and environmental vulnerability caused by climate change impacts on water resources based on regional specificities.

RCP4.5 and RCP8.5 are representative concentration pathways, climate-change scenarios developed by the Intergovernmenta Panel on Climate Change (IPCC) that express radiative forcing in climate-modelling work. RCP4.5 has radiative forcing of 4.5W/m^2.

Temperatures will continue to increase to the end of the century from between 1.2°C–1.9°C at mid-century and 1.5°C–2.3°C end-century (RCP4.5) to 1.7°C–2.6°C mid-century and 3.2°C-4.8°C end-century (RCP8.5)

Precipitation is decreasing. –90 mm in average annual precipitation in the Atlas Mountains by mid-century under RCP4.5, –90 to –120 mm in average annual precipitation in coastal regions by the end of the century (RCP8.5)

Extremes. The number of very hot days (> 40°C) will increase significantly, the number of consecutive dry days will increase to a more moderate extent with the annual days with precipitation >20 mm being limited.

Vulnerability is higher in the south. The Maghreb, Levant and Zagros mountains are less impacted and more adaptable to change, but the southern third of the region, the south-western Arabian peninsula, Sahel, Southern Sahara desert and Horn of Africa exhibit highest vulnerability.

The lower Nile River basin has the greatest population density and high sensitivity to change, but adaptive capacity is high in some parts.

Source: ESCWA et al., 2017.

peninsula after 1997. To date, a trend of 0.21°C/decade increase is observed; relative indices show significant warming trends for the majority of stations in all seasons; however, strong warming (<5 days per decade) is witnessed in spring, summer and autumn.[17]

RICCAR also projects an overall trend toward more extreme weather conditions across the region.[18] Changes in the number of hot and very hot days and increased night-time temperatures have significant consequences for human and animal health conditions, and will affect water resources, with further consequences for food security through the dual effects of rising temperatures and reduced precipitation in agricultural sectors. In its NDC submitted to the United Nations Framework Convention on Climate Change (UNFCCC), Egypt cites studies that show climate change is expected to reduce the productivity of two major crops in Egypt—wheat and maize—will be reduced by 15 percent and 19 percent, respectively, by 2050, owing to frequent temperature increases, irrigation water deficit, pests and plant disease. In addition, 12 percent to 15 percent of the most fertile arable land in the Nile Delta is expected to be negatively affected by sea-level rise and saltwater intrusion.[19] This enormous potential loss in agricultural productivity would have vast consequences on Egypt's population working in agriculture, its export revenues, and its own food security: an alarming prospect that also stands as an example for other agrarian economies in the Arab region.

Effects on peace and social cohesion

Climate change has direct and indirect effects on the well-being of people. Its impacts extend beyond the environment to economic, social and political life, threatening human security and sustainable livelihoods. Social groups such as women and children, low-income earners, and those living in rural areas are particularly affected, as they face greater obstacles to accessing resources in order to cope with the negative consequences of climate change. Climate change profoundly threatens progress in wider sustainable development, including the reduction of inequalities including inequality of gender, and decent work opportunities and economic growth. A recent ESCWA report describes climate change as a "threat multiplier, further compromising livelihoods, exacerbating human, food and water insecurity, and increasing internal and external displacements."[20]

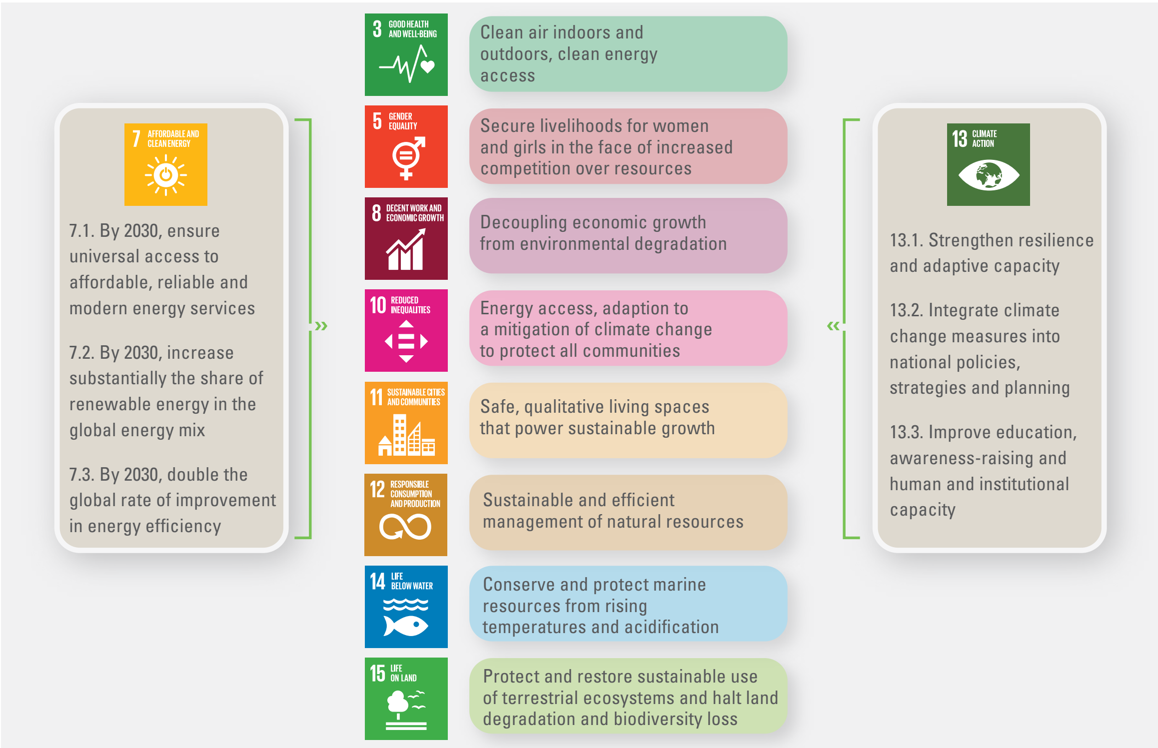
Climate-related natural disasters and extreme weather events are a potential trigger for future conflict in the Arab region. Food insecurity, especially the increase in prices and unavailability of products, decline in agricultural viability and low access to natural resources can be a potent source for fought-over resources such as water and arable land; they are also a likely source of sociopolitical discontent that can contribute to political uprisings and instability.[21] Climate stress through recurrent droughts and subsequent large-scale migration to cities in the Syrian Arab Republic between 2006 and 2011 has been considered by some as a contributing factor to the political discontent of those taking to Syrian streets in 2011.[22] In Yemen, the ongoing conflict has hindered the access of 20 million people to clean water, and clashes over water have caused around 4,000 deaths a year.[23] In the past, the conflict in Darfour was described by the United Nations as the "first climate-change conflict" driven by water scarcity.[24] More such conflicts over water and other natural resources are a dire prospect in the Arab region, constituting a severe threat to development and sociopolitical stability in this century.

SDG 7 and SDG 13 are closely interlinked

Progress in sustainable energy and climate action are closely interlinked. The burning of fossil fuels to supply the world's growing populations and economies with energy has been a key cause of the release of carbon dioxide and other greenhouse gases into the atmosphere that is linked to climate change.[25] Decoupling economic growth and prosperity from energy use, by increasing the share of sustainable, clean energy sources and by increasing the efficiency and productivity of energy use as envisioned under SDG 7 is hence a key step to climate action under SDG 13. In turn, climate action through channels such as climate finance, international project cooperation and awareness-raising, can play an important role in driving changes in the energy and related sectors, such as industries and transport.

Climate action is overwhelmingly aligned with a large array of sustainable development goals in its own right. Work by the International Climate Initiative in Germany and the World Resources Institute found that indicated climate actions were aligned with the majority of SDG targets.[26] There is also widespread recognition that neither agendas will reach their full potential without sufficient progress in the other. The two development goals SDG 7 and SDG 13 therefore go hand in hand in facilitating progress across a range of other development goals, including the promotion of human health, gender equality and the creation of safe, resilient living spaces, in addition to the protection of natural resources on land and at sea (Figure 50). Some of these are discussed in more detail below.

Figure 50. SDG 7, SDG 13 and their relation to other sustainable development goals



Source: Authors based on the 2030 Agenda for Sustainable Development

Human health

Climate change in the Arab region has the potential to threaten health and well-being. Heat stress and heat-related illnesses, extreme weather events, water scarcity, as well as rising health issues due to deteriorating air quality, changes to the distribution of disease vectors, and the overall effects on people of the loss of livelihoods are all climate-related risks. Climate effects on agricultural production through rising temperatures, extreme weather conditions and water scarcity additionally threaten food security, with the risk of undernourishment of children, particularly in high-impact countries. Waterborne infectious diseases are expected to worsen as climate-change impacts such as increased temperatures, flooding, and other changes in the water cycle occur.[27] Related environmental problems such as desertification, and conflict over access to resources will exacerbate the risk of climate-poverty.[28] Progress in SDG 7 through a more sustainable use of energy not only helps mitigate climate change, but also forms a critical part of the adaptation of local communities, safeguarding productivity and economic opportunities, and a wide range of other sustainable development goals.

Socioeconomic inequalities and gender

Climate change exacerbates social, economic and demographic inequalities by straining the social and environmental systems that support good health. Environmental changes are affecting land coverage, such as the availability of fertile land, fishing grounds at sea, desertification and natural disasters, will all affect the livelihoods of people across the Arab region, leaving some more behind than others. Rural populations and low-income groups are most vulnerable to these emerging challenges. Building sustainable energy and water systems that empower all members of Arab societies to access education, health services and economic opportunities inside and outside cities is crucial to the resilience of the region's long-term prosperity and stability.

The negative impacts of climate change, as well as lack of access to modern energy, weigh more heavily on women, aggravating already existing gender imbalances. Women are often impeded in their access to resources to adapt to climate change, while, in many cases, they are also excluded, or severely underrepresented, in decision-making that affects climate-change adaptation and mitigation efforts, the distribution of resources and ultimately their and their families' livelihoods. Their limited access to credit facilities, as is the case in Iraq, the Sudan and Yemen, is an example of the obstacles they face.[29]

Better access to modern energy and climate-change adaptation and mitigation efforts all benefit women and their access to education and health facilities. In the context of income poverty, women and girls are often traditionally responsible for securing water and biomass for cooking and washing, which, in turn, affects their ability to attend school or engage in paid work. Studies from Yemen illustrate this.[30] Women are highly vulnerable to the further negative effects of natural disasters, economic decline and conflict over resources as a result of climate change in the coming decades. Ensuring universal access to sustainable, clean energy and water for all while mitigating and helping rural communities adapt to the negative effects of climate change are hence policies that go hand in hand in ensuring viable livelihoods for this and future generations.

Resource efficiency, infrastructure and sustainable human settlements

Climate action encompasses a wide range of policies that improve what people and the economy gain from finite natural resources, including energy. Increasing the efficiency of energy use across sectors and boosting the use of cleaner fuels such as renewable energy is an integral part of SDG 7, as well as other SDGs such as SDG 8 (decoupling economic growth from environmental degradation) and SDG 12 (ensuring sustainable consumption and production patterns by achieving the sustainable management and efficient use of natural resources by 2030).[31]

Rising temperatures will increase the need for air conditioning and, hence, residential energy consumption. With summer temperature peaks above 50°C in parts of the GCC, air conditioning already accounts today for around 70 percent of total energy consumption in a typical building, with buildings consuming around 75 percent of total electricity demand.[32] In 2012, Strategy& estimated the cost of installing all the GCC's cooling capacity by the beginning of the decade at USD 50 billion, with a yearly fuel opportunity cost of approximately USD 20 billion. By 2030, Strategy& projects that cooling demand in the GCC will nearly triple, costing governments some USD 100 billion for new cooling capacity and over USD 120 billion for new power capacity if it maintains its existing pattern of technology deployment.[33] While air conditioning in the GCC is already a necessity rather than a luxury, other parts of the Arab region are expected to see demand for cooling systems rise, driving demand for energy. Effective, structural energy efficiency measures such as MEPS and building energy efficiency codes will be key to improving well-being, while minimizing the growth in building-cooling energy use and emissions.[34]

The Arab region has in recent years seen an increasing number of projects and innovative technology solutions in pursuit of sustainable energy which also benefit the climate. Examples include solar heating in Morocco, the State of Palestine and Tunisia; CNG introduced as transport fuel, as well as green building councils in Egypt and the United Arab Emirates; the construction of Masdar city, in Abu Dhabi, aimed to demonstrate innovative urban low-emission concepts; and tax exemptions on imported hybrid cars in a number of Arab countries.[35] While many of these projects remain separate and dispersed, they successfully demonstrate the cost-effectiveness of a number of modern technologies at the national and regional level, with benefits that reach beyond immediate cost savings through their parallel positive effect on GHG emissions.

There is large potential for productivity gains to increase value added while reducing emissions. While competitive global pressures are an important driver for change, Arab region expertise in oil and gas processing and value-adding processes enables new innovations and is an area where the region can lead progress. Box 16 highlights recent progress from two of the largest global producers of carbon intensive products from the region.

Environmental management

The Arab region is facing major environmental challenges, including water pollution and chronic water shortages, air pollution, deforestation and land degradation, and long-term damage to ecosystems and local biodiversity. Environmental changes are affecting land coverage owing to increasing agricultural activities; diversification of land use, primarily towards tourism and mining activities; heavy deforestation; overuse of land, water and fishery resources and overpopulation, along with rapid growth of urban areas. Desertification, climate change, pollution and armed conflicts are resulting in grave degradation of natural resources.[36]

Box 16. Energy efficiency and carbon-productivity in Saudi industries

Saudi Arabia has a long-standing energy-management programme aimed at increasing the efficiency of its energy-intensive industries. The country is pursuing a 35 percent reduction in energy consumption in its buildings, transportation and communities by 2020.

National oil company Saudi Aramco has been a flagship element in this pursuit, having improved its upstream process efficiency tremendously over time. Saudi Aramco's flaring levels are industry-leading at less than 1 percent of annual gas volumes. Saudi Arabian crude oils have some of the lowest carbon intensities: 4.1g CO_2eq/MJ. This is an extraction energy- efficiency indicator as it reflects management of highly productive reservoirs (high productivity index), low water production (leads to lower mass lifted and less energy expenditure in separation per unit of oil extracted) and low flaring rates.

The Peak Summer Production Programme provides additional non-associated gas to displace 11.5 million barrels of crude oil for power plants while reducing emissions; 1.3 GW of new cogeneration systems retrofitted into existing plants; replacing 4,000 company vehicles with more efficient models; a 60 percent reduction in building lighting energy from sensor-controlled LED lighting retrofits; and collaboration with the Saudi Energy Efficiency Programme to promote energy efficiency practices through awareness campaigns.

SABIC, another key stakeholder in the Saudi economy and the world's fourth largest chemical company, has goals to reduce 2010 baseline levels of GHGs, energy, and water intensities by 25 percent, and material-loss intensity by 50 percent, by 2025. In 2016 it used 750 PJ globally, emitting 56 million tCO_2eq. In 2017 it reported reductions in GHG intensity by 9.3 percent, energy intensity by 7.6 percent, water intensity by 8.8 percent and material loss by 35 percent. Flaring was reduced by 43 percent. In May 2019 Saudi Aramco purchased 70 percent of SABIC in order to further develop downstream value.

Sources: Nature Energy, 2018.
Saudi Aramco, 2019.
SABIC, 2017.

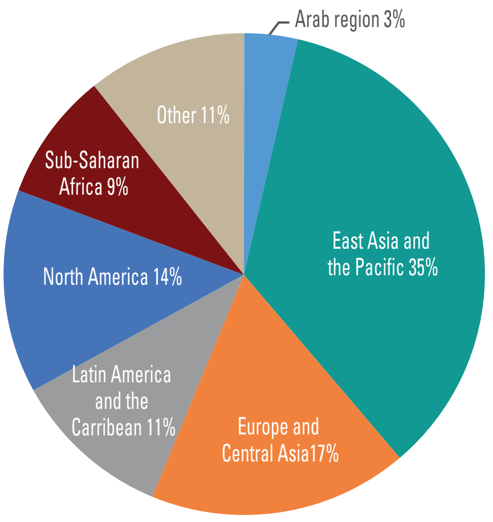
Environmental management in the Arab region requires urgent action. Land, water and sea resources are critical for socioeconomic growth and sustainable development across the Arab region, yet policy responses have been lacking. Climate action under SDG 13 through policies aimed at improving land- and water-resource management, reducing air pollution, emissions and global warming, and the creation of sustainable energy systems under SDG 7 form an elemental part of the acutely needed response by Arab countries to the region's many environmental challenges (SDGs 14 and 15). Public communication, information management, changing incentive structures as well as strengthened cross-boundary information as proposed under SDG 13 offer further opportunities to integrate the protection and effective management of the Arab region's finite natural resources into national policymaking.[37]

Air pollution and the carbon footprint

Climate action is urgently needed to respond to the Arab region's rapidly rising carbon footprint. While the region does not account for the largest part of global GHG emissions, it is the fastest growing emitter of GHG emissions worldwide (Figure 51 and Figure 52). Except for Libya, all Arab countries' emissions increased above world average in the GCC and the Sudan by many multiples (Figure 53). Data for several Arab countries, including Kuwait and Saudi Arabia are missing, both being large emitters whose exclusion from current data means actual regional emissions must be considered larger than indicated by available data. Qatar, which is one of the region's largest emitters of GHGs, has also seen a dramatic increase of over 800 percent in the amount of methane emitted since 1990,[38] the result of its large natural gas industry.

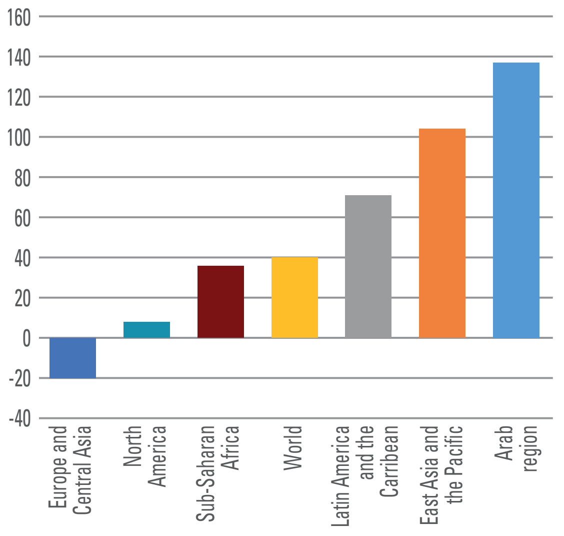
In addition, total GHG emissions, per capita CO_2 emissions have also been growing fast across Arab countries. The GCC economies have already some of the highest per capita emission rates in the world, owing to their large energy industries and their small populations, while emissions are increasing fast everywhere else in the Arab region. These results are highly concerning from a climate perspective and highlight the need for Arab countries to tackle their emissions growth as a matter of urgency.

Figure 51. Total greenhouse gas emissions ($ktCO_2$ eq) by world region, 2012



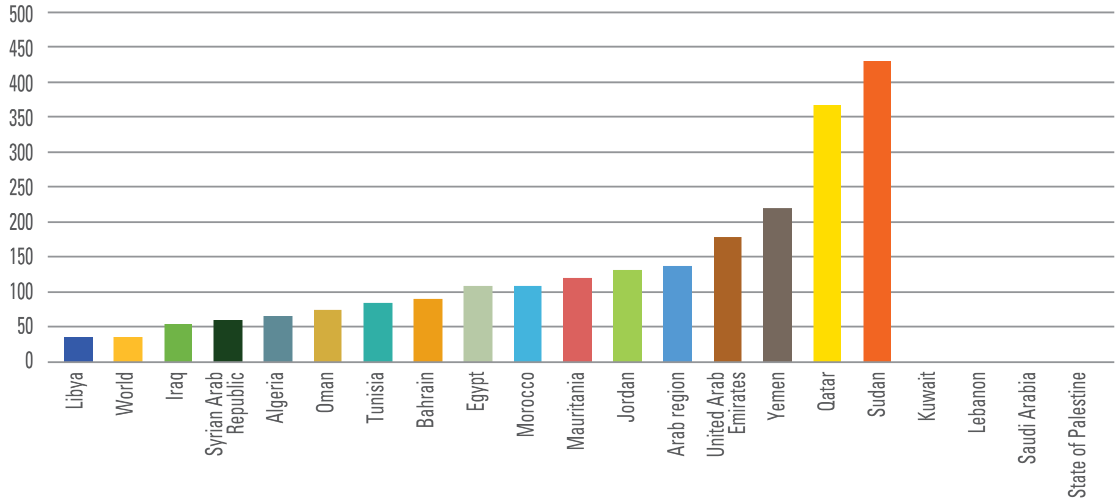
Note: Arab region in this figure includes Comoros, Djibouti and Somalia as per World Bank aggregate regional definition.
Source: World Bank, 2019b.

Figure 52. Total greenhouse gas emissions (percent change from 1990), 2012



Note: Arab region in this figure includes Comoros, Djibouti and Somalia as per World Bank aggregate regional definition.
Source: World Bank, 2019b.

Figure 53. Total greenhouse gas emissions by country (percent change from 1990), 2012



Source: World Bank, 2019b.

Arab countries also suffer from highly concerning levels of ambient air pollution. Annual mean exposure to fine particulate air pollution (<PM 2.5 particulates) exceeds WHO guideline values in all Arab countries. WHO outdoor air-quality data also show the Arab region is one of the most particularly polluted regions worldwide (Figure). Data gaps and the fact that many urban and industrial centres will exceed country average levels are highly concerning.[39] Air pollution does not originate exclusively from human activity and can be greatly influenced by duststorms, particularly in areas close to deserts.[40] This explains why ambient air pollution measured in rural areas in many Arab countries exceeds air pollution in cities.[41] Arab cities also are subject to high air pollution, however. Two Saudi cities—Riyadh and Al Jubail—are among the world's 10 most polluted cities measured on the basis of PM 2.5 pollution; several others in Saudi Arabia, other GCC states and Egypt feature amongst the most polluted cities further down the list.[42] Alongside extractive industries, transportation and industrial activities are the main sources of air pollution in the region, exacerbated by seasonal sand- and duststorms.[43] This highly concerning situation necessitates urgent policy action to be taken in order to protect citizens from the detrimental effects that current air quality will have on public health.

Conflict and political instability negatively affect the region's progress in improving air quality. Intensified conflicts and political instability in countries with ongoing conflicts such as Iraq, Libya, the Syrian Arab Republic and Yemen, in addition to other long-standing conflicts such as in the State of Palestine have disastrous effects on energy access and service quality. Some of the main challenges these countries' energy sectors are facing are the lack of investment in the maintenance and upgrading of energy systems, including electricity plants, and T&D infrastructure; or, as one article in The Economist puts it: "War stops people from … planting trees."[44] Political instability prevents focus on long-term policies such as environmental policy, regulation and the restructuring of energy sectors, directing decision-making instead to short-term stop-gap measures. Iraq for instance has been relying heavily on fuel oil and heavy fuel oil for power generation, and household use of diesel generators is frequent owing to the lack of grid-based electricity service reliability,[45] with far-reaching consequences on the emission of air pollutants as a result.

Climate action in the power and water sector

Energy and water are intrinsically linked. Energy (usually in the form of electricity) is used to extract groundwater, to power desalination plants, to treat, pump and distribute water and, at the end of cycle, to collect wastewater and operate its treatment plants. Water is essential for fossil-fuel extraction, production and processing, for energy production in hydropower plants, thermal power plants and renewable energy production. Arab countries face immense challenges in both the water and energy sectors with growing populations and mounting environmental pressures such as droughts, desertification, pollution and climate change.[46] In the GCC, efficiency gains have been realized in the utility sector following investment in CCGT and new desalination technologies (see Box 17).

Climate action is closely linked to improvements in the efficiency of water and energy use in the utility sector. The intrinsic link between energy and water necessitates comprehensive action that addresses the two elements together. Several regional initiatives have confirmed this necessity and called for systemic change (see also Box 18). For instance, in 2011, the Arab Ministerial Water Council (AMWC) of the Arab League adopted the strategy to unify and guide efforts in managing water resources. AMWC approved an action plan in 2014 to put the strategy into operation, including targets to increase energy efficiency within the water sector by 30 percent within five years; and to reduce GHG emissions. In 2013, the Pan-Arab Strategy for the Development of Renewable Energy Applications 2010–2030 was ratified at the third Arab Economic and Social Development summit in Riyadh, presenting a roadmap for renewable energy development in the region over a 20-year period. A year later, in 2014, AMWC

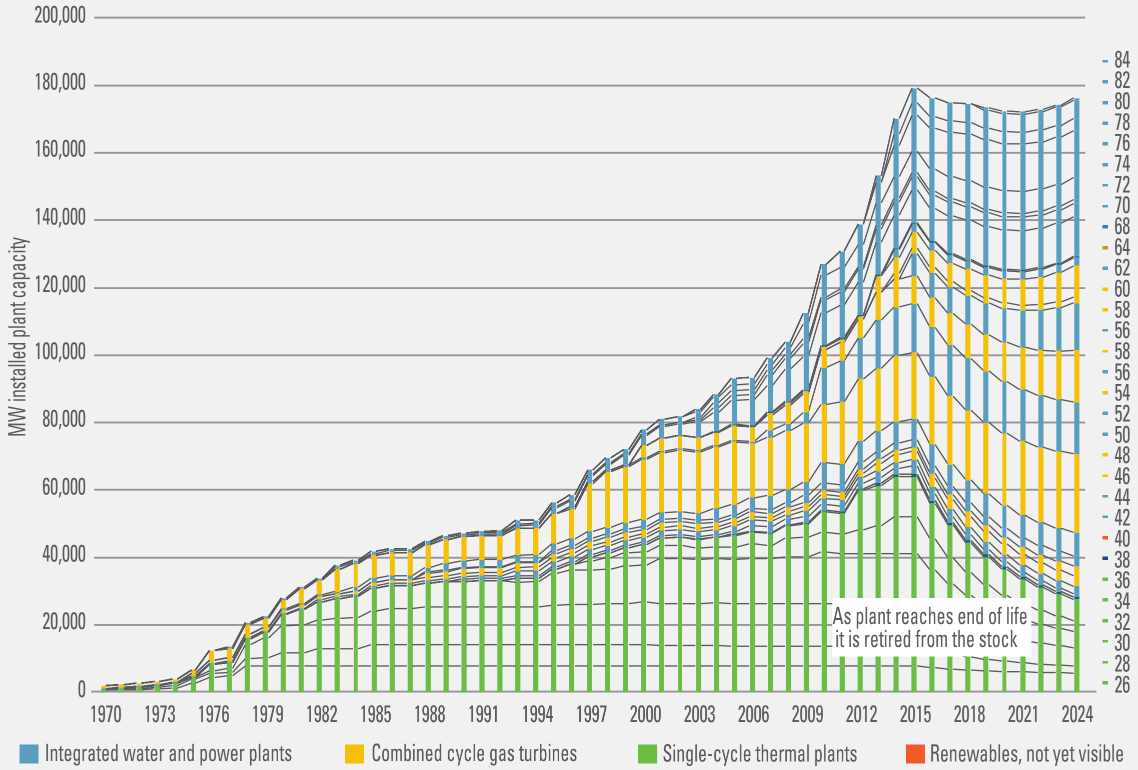
Box 17. A stock model of GCC power–water plants

As new power and water production technologies have been adopted over time, the efficiency of power and water plants in individual countries, and the region as a whole, has improved. Stock models show the technological development of a stock or fleet of products over time. By documenting temporal features: introduction to the fleet, retirement or replacement rate, along with key performance or physical attributes such as size and efficiency on a common time base, a representative and accurate model of the evolution of the stock in a system can be constructed. The key benefit is that the plant stock is described by a number of key variables rather than single indices and changes in key variables over time can be seen.[a]

The figure below offers an illustrative stock model of GCC power–water plants that highlights the evolution in key plant types by rated capacity and their improving efficiencies from 1970 to 2025. Plants are ranked by capacity and efficiency from their commissioning dates to decommissioning and colour-coded to highlight the distribution of key plant types in the stock. Note that the model represents rated capacities, is based on public information in 2015 and does not represent capacity or energy output under actual operating conditions. Stand-alone desalination plants are not included, the model includes identified power plants and integrated water and power plants only.

As demand grows over time, and power plant technologies advance, higher efficiency combined cycle (yellow) and integrated water and power plants (blue) are added to the stock of older single-cycle power plants (green). This is shown as growth in installed plant capacity (MW) on the left axis. Plant efficiency is shown in steps of 2 percent efficiency in the legend to the right. As new plants are added, the efficiency of the system improves, as new highly efficient plant is widely operated and older, less efficient, plant used only under peak load conditions.

Installed capacity in the GCC by plant type and efficiency (MW)



Sources: KAPSARC Power–Water Database. Delft University of Technology, IHS, installer and supplier data sources. 2015.

[a] Bucher, M, 2010.

[b] The efficiency of electricity and heat production in public conventional thermal power plants in the EU28 countries increased from 42 percent in 1990 to 49.7 percent in 2018. The average efficiency for district heating conventional thermal power plants in the EU28 in 2013 was 84.6 percent. (EEA, 2018)

Substantial investments in high-efficiency CCGT and integrated water and power plants (IWPP) undertaken in the past five decades have provided GCC countries with energy- efficient power plants. Some of the highest efficiency plants are world-leading. The older, inefficient single-cycle power plants tend to be used only for peak management and most were planned to be phased out from the stock. Despite the low cost of fuel for power and desalination, the power plants and IWPP efficiencies in many Arab region countries are on a path similar to Europe,[b] where substantial energy-import costs and market economics dictate high plant efficiencies. Policies to promote these solutions integrate well within the objectives of both SDG 7 and SDG 13.

Over 40 percent of power-plant capacity in the example provide generator-exhaust heat to operate IWPPs. While these offer improved efficiency of primary fuel use, IWPPs must juggle a complex nexus of variable power and water demand to fully optimize plant operation. While reverse osmosis plants use technically less final energy per unit water produced, there is less difference in primary energy consumption per unit of water produced by them compared to multi-stage flash or multiple-effect distillation plants. The different plants are better suited to different water resources and the quality of water, salinity and turbidity tend to determine plant selection, not just the energy intensity of water production.

Box 18. Regional initiatives to address water security and climate change

There have been a number of regional initiatives with the aim of championing improved water governance cross-boundary cooperation in the Arab region in the past decade. The Arab Ministerial Declaration on Climate Change (2007) expressed the commitment of Arab countries to move towards climate-change adaptation and mitigation, followed by the Arab Framework Action Plan on Climate Change (2010–2020).

In addition, all Arab countries are signatories to the UNFCCC, identified adaptation and mitigation actions in their NDCs and submitted them to UNFCCC in 2015, along with emission-reduction targets. The high degree of economic and social vulnerability to the expected vastly detrimental impact of climate change on regional water resources is evident from a number of Intended Nationally Determined Contributions (INDCs), including those of Egypt, Jordan and the Sudan.[a]

The Arab Water Security Strategy (2010–2030) was adopted in 2011 and proposes a series of measures to respond to the region's water-scarcity challenges. It is complemented by an action plan that includes a set of implementation projects focused on water-use efficiency, non-conventional water resources, climate change, integrated water resources management, and water security.

In response to resolutions adopted by AMWC, the Council of Arab Ministers Responsible for the Environment (CAMRE), ESCWA's 25th Ministerial Session, as well as inter-agency collaborative processes involving the specialized and regional organizations of the United Nations and the League of Arab States, RICCAR was launched in 2010.

Furthermore, ESCWA and its partners conducted a series of consultations and capacity- building workshops with Arab governmental and non-governmental stakeholders throughout the 2010s, to help distill a regional perspective on the 2030 Agenda and climate change, and to further capacity-building in the area of climate negotiations in Arab countries (also see Box 19). One concrete outcome was the establishment of the Arab Centre for Climate Change Policies in 2018 that builds upon the RICCAR regional knowledge hub.[b]

Source: ESCWA, 2017b, p. 31.
[a] All INDCs are available on the UNFCCC website: https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx.
[b] ESCWA, 2018g.

and the Arab Ministerial Council of Electricity passed resolutions inviting the Arab League, the German Society for International Cooperation and ESCWA to solicit funding to implement nexus-related activities and studies in support of the regional initiative.[47] While all of these initiatives demonstrate the interest of regional governments in the energy–water nexus, a challenge remains to translate targets and intent into concrete and effective policy action.

Water and energy often remain mismanaged as interrelated resources. In consuming water to generate electricity, electricity plants' inefficiencies result in serious deterioration of water and other environmental resources.[48] UNDP observes in the context of the Arab region that

> "Water and energy are run by separate utilities that do not always share the same interests or priorities; combining them could improve coordination. The energy sector in many Arab countries is dominated by state-owned monopolies of low efficiency, and mismanagement is common. Awareness of water and energy perspectives and their interdependence are essential for effective water governance and management."[49]

Increasing demand for desalinated water necessitates more effective co-management of water and energy in the utility sector. In countries such as Qatar and the United Arab Emirates, almost 30 percent of fuel consumed during power and water generation is due to desalination.[50] Membrane-based desalination, such as reverse osmosis has become the preferred technology used in the GCC because of its energy- and hence cost-effectiveness: membrane technologies can save 75 percent of energy and cut water production costs by two-thirds compared with thermal technologies, while the total energy footprint for membrane technologies is five times less than thermal technologies.[51] ESCWA observed that failure to move to membrane technology in the past stemmed in part from the "lack of human capacity", along with robustness and integration of water production with electricity generation.[52]

There are also potential benefits to be reaped by further integrating renewable energy into the energy-desalination sector. The most important application is clearly the gradual electrification of desalination, along with gradually integrating higher shares of renewables into the overall electricity mix. In a 2019 study, IRENA concluded that this was the most likely application of renewable energy in the desalination sector.[53] On the other hand, co-locating desalination and renewable installations such as solar PV plants may be particularly attractive in specific cases, for example, remote off-grid settings or if a utility decides to build a co-located system with low emissions.[54]

Green finance offers a window to more public and private investment into energy efficient technology. Financing in the form of credit lines and grants comes from a number of international development bodies, as well as from domestic sources in some Arab countries. Some examples are the following:

- ***Jordan*** was one of the earliest proponents of green finance in the region, through public tools such as the Jordan Renewable Energy and Energy Efficiency Fund (JREEEF), commercial banks, micro-finance institutions as well as international financial institutions.[55] In 2014, a Development Policy Loan of USD 250 million issued by the International Bank for Reconstruction and Development (IBRD) supported Jordan in diversifying its fuel supply for power generation and shifting power generation to cleaner renewable energy, increasing efficiency in energy and water.[56]
- In ***Tunisia***, IBRD supported improvements to the efficiency of water use in irrigation and increased the capacity for climate adaptation between 2009 and 2015 with EUR 27.3 million. The project promotes more efficient use of irrigation water and drinking-water supply in rural areas and increased capacity to plan for current and future water-management challenges, including climate change.[57]
- ***Morocco*** obtained funding from the African Development Bank, the Official Credit Institute of Spain and the Global Environment Facility (GEF), with the balance being paid by the Office National de l'Électricité to test the viability of solar thermal technology at Ain Beni Mathar and the Integrated Thermo Solar Combined Cycle Power Plant. The success of the project laid the groundwork to scale up and secure the more than USD 3 billion needed for the Noor-Ouarzazate complex from the World Bank, the Climate Investment Funds' Clean Technology Fund (CTF), the African Development Bank and European financing institutions. The results were cost reductions and the commercial adoption of large-scale, low GHG-emitting technologies in power generation, while demonstrating the viability of thermal technology in Morocco and for replication elsewhere.[58]

Consumer pricing still imposes challenges to rationalizing energy use in the utility sector. The decades-long practice of subsidizing energy and water in many Arab countries has resulted in low incentives for both consumers to rationalize the use of energy and water and for producers to invest in upgraded technologies and alternative fuels.[59] In the GCC, this pattern is most distinct, given the very high per capita incomes of consumers coupled to some of the world's lowest prices for energy, with reforms having started only a few years ago.[60] In Abu Dhabi in 2006, for example, electricity was priced at 1.4 USD cents/kWh for nationals and 4 USD cents/kWh for expatriates. Nationals each consumed on average 71,000 kWh/year, compared with 26,500 kWh/year for expatriates.[61]

Box 19. Sustainable energy transition; zero emissions by 2050 in the Arab region

A 2019 study by Finland's Lappeenranta University of Technology and the Energy Watch Group simulates a global 100 percent renewable energy pathway. The study features results for the Middle East and North Africa (MENA) which includes 16 Arab countries, for which the results are the following:

Primary energy demand, with high electrification **increases up to 10,500 TWh by 2050 from 7,800 TWh in 2015.** The massive gain in energy efficiency is primarily due to a high level of electrification of more than 90 percent, reducing demand by around 17,500 TWh by 2050. Current practices, if maintained until 2050, however, lead to primary energy demand reaching 28,000 TWh by 2050.

Solar PV supply increases from 42 percent in 2030 to over 90 percent by 2050, becoming also the lowest cost energy source. Wind energy increases to 38 percent by 2030 and declines through the transition to around 8 percent by 2050. Advances in energy-storage technology plays a critical role in powering this transition.

In the heat sector, heat pumps play a significant role with a share of 37 percent of heat generation by 2050.

The total annual costs are in the range of EUR 290-520 billion (USD 323–580 billion) through the transition period distributed across the power, heat and transport sectors and a smaller share for desalination.

The levelized cost of energy (LCOE) declines substantially from around EUR 75/MWh (USD 83/MWh) in 2015 to over EUR 55/MWh (USD 61/MWh) in 2050. Capital costs increasingly dominate as fuel costs decline through the transition, meaning increased levels of energy diversification across MENA by 2050.

The cumulative investments are about EUR 5,000 billion (USD 5.6 trillion) through the transition from 2016 to 2050.

The total installed power generation capacities increase from nearly 400 GW in 2015 to around 2,800 GW by 2050; 2,300 GW solar PV and 140 GW wind-installed capacity by 2050.

Electricity generation increases to 4,900 TWh by 2050, from 1,400 TWh in 2015, primarily from PV and wind. Heat generation increases to around 3,100 TWh by 2050, from over 1,600 TWh in 2015, predominantly from heat pumps with some solar thermal, non-fossil gas and biomass-based heating.

The LCOE of the power sector decreases substantially to EUR 52/MWh (USD 58/MWh) by 2050 from around EUR 98/MWh (USD 109/MWh) in 2015.

In the transport sector, the relatively low costs of car ownership and high status of owning private cars in the MENA region, are projected to drive higher levels of car use by households in the future. Additionally, substantial demand for fuel-conversion technologies occurs beyond 2040, in producing renewable-based fuels for the transport sector. The final energy demand of the transport sector across MENA is around 1,800 TWh in 2015. This demand increases through the transition to around 2,500 TWh. Electrification of the transport sector creates an electricity demand of around 3,800 TWh by 2050. Hydrogen constitutes more than 27 percent of final energy demand in 2050.

Source: Ram, M. et al , Global Energy System based on 100% Renewable Energy: Power, Heat, Transport and Desalination Sectors. Study by Lappeenranta University of Technology and Energy Watch Group, Lappeenranta, Berlin. Middle East North Africa region (Section 3.4, 80–93) March 2019. http://energywatchgroup.org/new-study-global-energy-system-based-100-renewable-energy

Aligning SDGs and NDCs

National energy plans and NDCs need to be better aligned with SDG 7 and SDG 13. NDCs are at the heart of the Paris Agreement and the achievement of these long-term climate goals. NDCs embody voluntary efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each Party to "prepare, communicate and maintain successive NDCs that it intends to achieve. Parties shall pursue domestic mitigation measures with the aim of achieving the objectives of such contributions".[62]

Less than half the Arab countries have undertaken a voluntary national review. This highlights the fact that, despite progress in energy access, few Arab region countries have tangibly advanced measurement of renewable energy and energy efficiency. Of the NDCs and voluntary national reviews completed, some countries are able to quantify the impacts of changing climate on land productivity and water availability. Countries such as Jordan, Tunisia, but also GCC members such as Kuwait and Qatar, and the Arab LDCs specifically highlight the various vulnerabilities to climate change in their NCDs, with Yemen explicitly citing competition over scarce natural resources, particularly water, as one of the key triggers for the social and political unrest that erupted in the country in 2011.[63] With an increasing sense of vulnerability starting to be recognized at the political level, increased focus and integration of policy options to address climate mitigation and adaption are being pursued in a growing number of Arab countries. Box 20, for example, highlights Tunisia's re-evaluation and recasting of its energy efficiency policies and recasting to make better progress with SDG 13.

Box 20. Progressing beyond energy efficiency in Tunisia to pursue SDGs and carbon objectives

Tunisia has pursued energy efficiency for the past 30 years. In 2019, it was ranked 19th out of 133 countries for sustainable energy policies by the World Bank RISE analysis and the leading Arab country (the United Arab Emirates follows at 33rd). In 2016, the country adopted an energy transition plan that aimed to reduce energy consumption by 30 percent. In its INDC submitted to UNFCCC in 2015, Tunisia further set a specific target of reducing carbon intensity in its energy sector by 46 percent, based on renewables and energy efficiency.[a]

In May 2018, the Ministry for Energy, Mining and Renewable Energy decided on a new series of measures as it had become clear to the Tunisian Government that the set goals would not be met at the current rate. The government decided, inter alia, to strengthen its energy-transition fund, which supports the improvement and operationalization of regulatory and technical measures to develop renewable energy.[b] Tunisia also intends to simplify administrative procedures, in particular for projects of less than 1 MW.

Furthermore, ACTE (township alliance for energy transition) programme will assist local authorities in implementing national policy in the field. Energy audits will be carried out in 350 towns, 65,000 homes will be insulated, solar panels installed on the roofs of government buildings and mosques, 400,000 old refrigerators will be replaced, and 4 million incandescent bulb and 450,000 public lighting points replaced with LEDS. The purchase of electric vehicles, which will gradually replace the vehicles used by government departments such as the postal service, will be subsidized. Capacity-building training for energy efficiency specialists will be carried out. A support and guidance bureau will assist project carriers who will have the advantage of a single legislative framework.

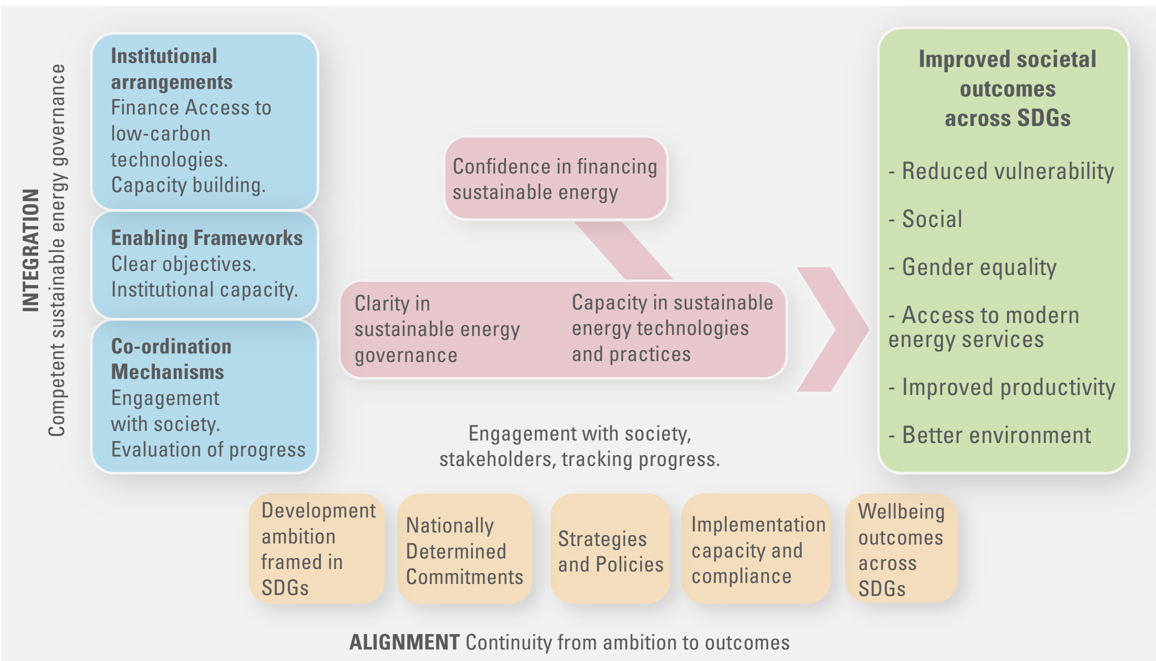
Sources: https://www.giz.de/en/worldwide/19529.html
http://www.rcreee.org/content/tunisia
https://en.econostrum.info/Tunisia-multiplying-energy-efficiency-schemes_a481.html
http://rise.esmap.org/scores
[a] Tunisia INDC
[b] UNDP, 2018a.

Regional economies have a lot to gain from aligning policies with the SDG framework. Some of these benefits include the use of emerging synergies, policy consistency and streamlining, and clear mandating. Aligning policies helps ensure that the broad spectrum of sustainable development goals are considered, substantial opportunities targeted, and country contributions effectively harmonized with global climate emission-reduction processes. Integrated resource planning allows better alignment of consumer needs with available resources: improved optimization of investments in new capacity, new energy efficiency and renewable energy technologies for society's needs. Strengthening government and public knowledge, through effective communication, good governance, and the rule of law is elemental in driving progress, from sustainable energy access to a more efficient use of natural resources and the attraction of investment flows into cleaner sources of energy. Global experience[64] as well as extensive resources focused on capacity development in the Arab region[65] offer relevant and useful insights. Figure 66 highlights these benefits.

Policy implications

Climate action needs to become an integral part of national policymaking. All Arab countries are signatories to the United Nations Framework Convention on Climate Change that requires all parties to work towards reducing GHG emissions and enhancing GHG sinks. Despite widely common declarations of intent, climate-related policies remain scattered in most Arab countries and have to yet become part of formal government plans through concrete measures, policies and public discourse. Political inertia, weak governance and unclear policy mandates have all been obstacles to mainstreaming climate-change policies into planning, policymaking and public discourse. In many cases, integrating climate action into policymaking will also need to involve a revision of politicians' past ambivalence to the topic as one of primary relevance to other nations, principally those which are responsible for the largest share of historical emissions.

Figure 54. Advancing the integration and alignment of policies for SDG outcomes



National energy planning needs to integrate the dual objectives of sustainable energy (SDG 7) with climate objectives (SDG 13). National energy-sector planning and regulation is one of the foremost sectors where climate action fits in well with existing objectives of making energy production and consumption in Arab countries sustainable. Transport, industry policy, and the building sector/urban planning are other areas where more dedicated focus on climate action would strongly overlap with existing SDG 7 objectives, through the promotion of modern energy access, renewable energy and energy efficiency. For Arab LDCs, it is important that sustainable development goals become part of the countries' own socioeconomic development plans and are sound investments in social and economic development, not just additional cost burdens to government budgets. SDG 7 and SDG 13 carbon mitigation objectives can be integrated into energy-infrastructure development plans, public transport development plans, urbanization and national housing projects, national building retrofits programmes, etc. Making greater use of available climate finance to help pursue sustainable energy targets promises to be a win-win for all involved, including Arab LDCs.

Finance for conventional energy systems needs to be re-directed to mobilize sustainable energy technologies. Both energy efficiency and renewable energy work best when implemented on the demand side along with electricity and water-conservation efforts. This enables reduced transmission and distribution costs, as well as power- and water-production costs but requires a shift from a supply side paradigm to one which seeks increasing system value for public and private investments in energy efficiency and renewable energy. This is also important for those countries that need to re-build utility systems after conflicts, where utility policies need to enable new lower cost and more resilient power systems with distributed energy efficiency and renewable energy. Targeted development aid, loans and other forms of financial support by international financing bodies and bilateral sources can significantly help countries build sustainable infrastructure rather than focusing them on short-term solutions. Enabling private finance through effective market regulation and the use of tools such as Super-ESCOs can be critical in helping countries mobilize resources but require institution-building and a credible regulatory and financial framework. Mobilizing these resources highlights that progress in SDG 7 and SDG 13 cannot happen in isolation from parallel institution-building efforts.

Education, research and development form an integral part of Arab countries' needed response in order to mitigate and adapt to climate change. The milestone UNFCCC agreement adopted in December 2015 by the Conference of Parties (COP21) in Paris "recognizes the need to strengthen knowledge, technologies, practices and efforts of local communities and indigenous peoples related to addressing and responding to climate change."[66] ESCWA has separately argued that

> "The importance of climate change education lies in its ability to shape and change the way people think and act. It raises awareness and builds human/institutional capacity for mitigation, adaptation, impact reduction and early warning."[67]

Mainstreaming the ideas of climate change and the sustainable management of energy and natural resources for the benefit of future generations needs to become a central element in public discourse, as well as school curricula, and for dissemination by the media. Investment in research and development will equip Arab countries not only with the tools to innovate and develop their own, tailor-made technology solutions for their individual local context, but will, in parallel, help spur economic value generation through new industries, creating valuable jobs.[68]

The lack of current policy focus—and public awareness – of ambient air pollution in the Arab region is additionally concerning. In view of the high potential impact of fine particulate matter and other outdoor air pollution on public health, it is imperative that national governments make data and information available to the public; invest in internal institution building, including through capacity-building and the professionalization of relevant institutions within government; and step up regulative tools, oversight and enforcement. As shown in this chapter, many relevant policy options interlink considerably with other development goals and entail many substantial socioeconomic benefits such as the creation of jobs, new business sectors, effective transport networks that help fuel-growing, thriving economies, and the management of scarce resources, competition over which will only intensify in the coming decades.

Effective climate action by Arab countries benefits from continued engagement at regional and international level. Regional governance and cooperation in the sphere of climate change and sustainable energy is particularly beneficial in areas such as policy coordination and agenda-setting; research and sharing of knowledge and information; technical assistance and capacity-building; and leveraging of finance.[69] Substantial work has been undertaken to integrate climate-related issues into national and regional development policies and programmes (see Box 21). Bilateral development aid is a separate route through which funds that are already underway could be channelled into specific projects that support the provision of sustainable, climate-friendly energy to local communities. It is the role of governments today to understand and communicate to their populations that the effective management of air, land and water resources is not a luxury problem of others, but a precondition to sustained economic growth and the creation of lasting wealth for this and future generations.

Box 21. The Arab Centre for Climate Change Policies at ESCWA

ESCWA has been supporting capacity-building of Arab climate-change negotiators since 2013, in partnership with the League of Arab States and, more recently, with support from the United Nations Environment Programme (UN Environment) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). In 2018, this work culminated in the establishment of the Arab Centre for Climate Change Policies. Based at ESCWA in the Sustainable Development Policies Division, the Centre includes both a technical bureau and an online platform that builds upon the RICCAR Regional Knowledge Hub.

At the heart of its mandate, the new Centre will support capacity building in Arab States and their institutions to integrate climate-related issues into national and regional development policies and programmes. In particular, the Centre will do so by:

- Providing technical assistance and advisory services to Arab States;
- Building the capacity of Arab States and regional stakeholders to strengthen institutional frameworks and develop programmes and policies;
- Supporting regional platforms to harmonize positions and build regional consensus;
- Promoting comprehensive responses to climate-related challenges affecting water, energy and food security; and
- Providing access to knowledge products and to regional data and information using the Regional Knowledge Hub.

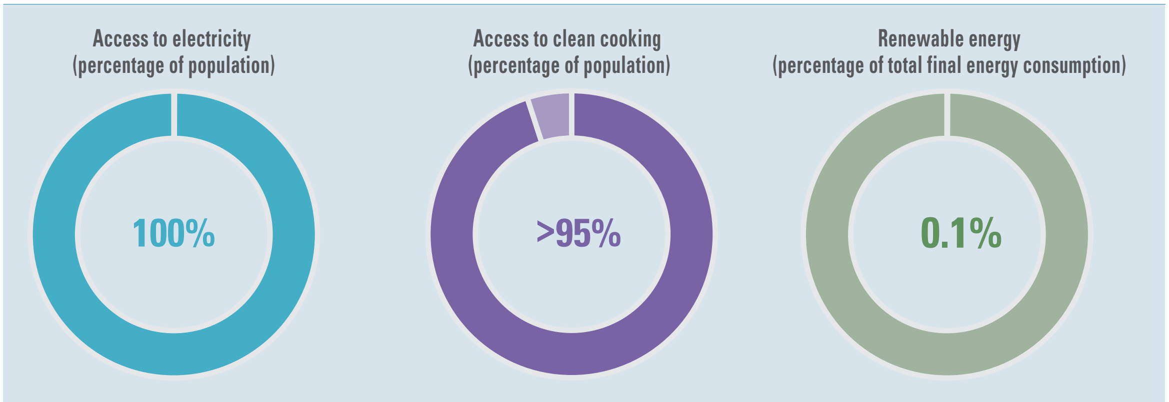
The resolution establishing the Centre complements the Beirut Consensus on Technology for Sustainable Development in the Arab Region, which is a declaration that reaffirms the commitment of Arab States to work together on harnessing the power of technology and innovation to build a more peaceful, prosperous and just future for everyone. Addressing these challenges is in line with efforts to achieve global goals adopted in the Paris Agreement and the 2030 Agenda for Sustainable Development in 2015 by the global community.

Source: ESCWA, 2018g.

5. Country Profiles

5. Country Profiles

Algeria



Energy access

Algeria closed its remaining electricity access gap during the 2000s and achieved near-universal access to electricity and CFTs by the early 2010s. Natural gas and LPG are widespread fuels for cooking[1], in addition to electricity, owing to government programmes to promote CFTs including through subsidies.

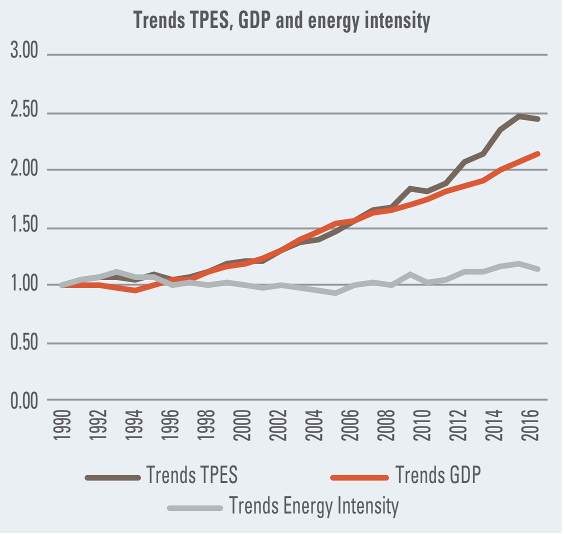
Renewable energy

Renewable energy contributed less than 1 percent to Algeria's TFEC in 2016, consisting of small amounts of solid biofuel, small-scale hydro, wind and solar power. The share of renewables as part of TFEC has declined by a factor of three since 2010, albeit from very low levels. The need to manage the domestic consumption of natural gas in the power sector to safeguard export volumes has prompted the Algerian Government to place increased policy focus on the promotion of renewable energy—in particular solar power—in the domestic power industry. Algeria's Renewable Energy and Energy Efficiency Development Plan of 2015 includes plans for the deployment of large-scale solar PV installations and onshore wind, to reach 22 GW or around 27 percent of the country's electricity generation by 2030, an ambitious target that will need to be substantiated through significant additional legislative and regulatory action.[2] Algeria has also seen increased use of solar water-pumps, and the use of solar mini-grids in some remote locations, including SONELGAZ's 5 MW Upper Plateaus Project, and more than 200 MW in small-scale mini-grids run by Shariket Kahraba wa Taket Moutadjadida.[3]

Energy efficiency

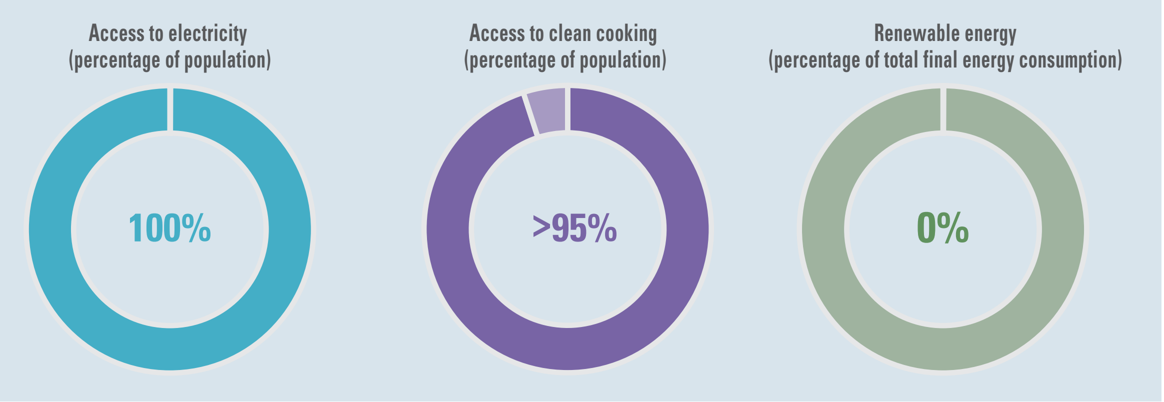
Since 1990, the only periods that Algeria's energy demand was lower than its GDP (in USD 2011 PPP) was during 2001 and 2003–2006. For the remaining time, no decoupling between economic growth and primary energy supply can be seen and primary energy supply grew faster than GDP since 2011 and levelled off in 2015. The drop in energy intensity in 2016 may indicate a turning point towards energy intensity improvement.

Algeria developed a roadmap for the implementation of a National Energy Efficiency Plan 2016–2020, which includes implementing several energy efficiency programmes in the different economic sectors: an ambitious programme in the building sector aims at improving thermal insulation and lighting, as well as promoting the installation of solar water-heaters at a large scale. Promoting the use of CNG in public transportation and disseminating large scale energy efficiency actions in the industrial sector, including promoting cogeneration and energy performance improvements of thermal and electrical processes. The National Energy Efficiency Plan targets a cumulative energy savings of 30 million ton of oil equivalent by 2030. [4]



While Algeria has a substantial set of regulatory policies with institutional capacity[5], and these should be coming to fruition, sustaining this recent progress will depend on addressing its implementation capabilities; monitoring progress of policies and ensuring compliance is achieved. It is also crucial that energy prices reflect costs of supply with power demand growth of 6.5 percent per year. Moreover, improvement of supply-side efficiencies is ensured by the new 13 GW of high-efficiency CCGT plants.

Bahrain



Energy access

Bahrain has been fully electrified and its population has enjoyed complete access to CFTs well before the 1990s. As a small island state, Bahrain derives most of its revenues from the export of oil products and boasts one of the highest per capita GDP rates in the world. Electricity and cooking fuels such as LPG are very affordable by regional and international standards.

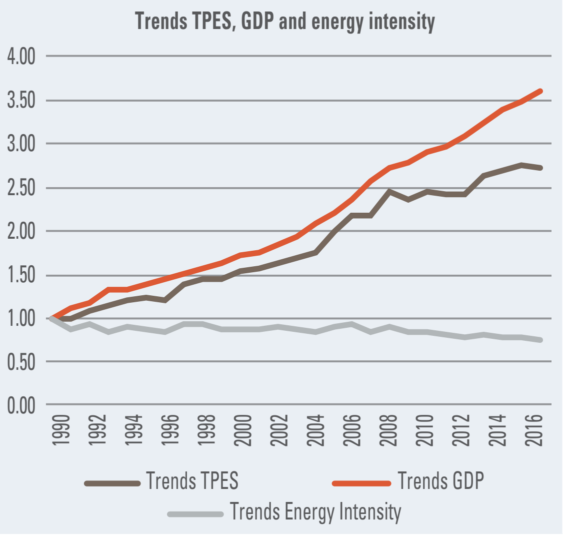
Renewable energy

Bahrain has not yet deployed any substantive renewable energy, with all of the small island-state's energy mix consisting of oil and natural gas. IRENA data suggest small-scale deployment of some 5 MW solar PV and 1 MW of wind capacity in the power sector.[6] The country has a target for renewable energy to contribute 5 percent and 10 percent of electricity generation by 2025 and 2035, respectively.[7] To this end, the Bahraini Government established a sustainable energy unit in 2014 and has since approved the NEEAP and the National Renewable Energy Action Plan (NREAP).[8]

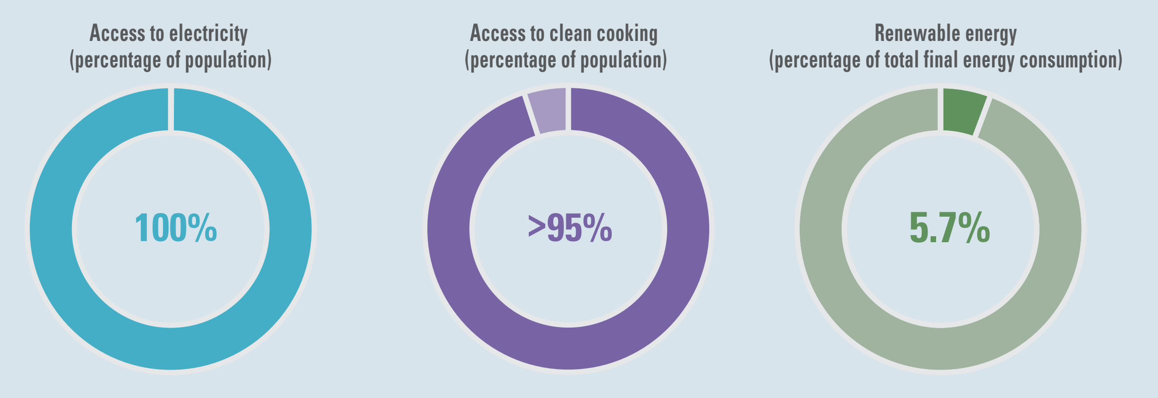
Energy efficiency

Bahrain has pursued strategies since the 1970s to develop service-related economic activities and was one of the first Arab nations to develop a well-established financial services sector. This diversification allowed Bahrain to decouple its economic growth from its primary energy supply since 1990, resulting in a long-term improvement in energy intensity from 12.6 in 1990 to 9.6 MJ/USD 2011 PPP in 2016. However, energy intensity needs to further progress in order to reach the target of doubling the rate of energy efficiency improvement. For a small island nation, Bahrain's energy intensity remains high with an industrial structure unusually dominated by the oil industry and a large aluminum smelter and its energy intensity remains above that of its neighbours. The power sector is dominated by relatively modern efficient CCGTs. Bahrain has energy prices below the regional averages.

The Bahraini cabinet established a sustainable energy unit in 2014, which has developed two key policy documents: NEEAP and NREAP, that have been approved by the cabinet for implementation. The Government supported their inclusion as a national priority and formed a Follow-up Committee.[9]



Egypt



Energy access

Since the 2010s, Egypt has achieved universal electricity access, with rates in 2017 at 100 percent, as well as CFT access rates of above 95 percent. Last remaining gaps in electricity access were closed during the 2000s, mainly in rural areas and informal urban housing. Egypt undertook substantial price reforms for electricity and liquid fuels—with the exception of household cooking fuel LPG—in July 2014, with no directly accompanying compensatory measures for vulnerable income groups.[10] This has made electricity significantly more expensive, with problematic effects on the affordability of electricity for low-income households, in particular.[11] LPG remains an important cooking fuel, especially in rural households, which use less electricity and natural gas.[12]

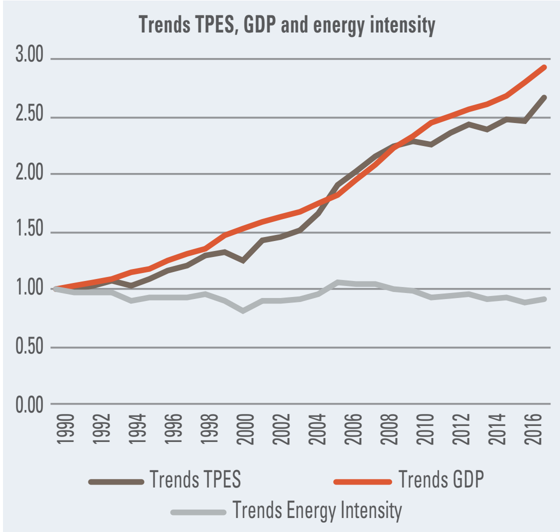
Renewable energy

In 2016, renewable energy contributed around 6 percent to Egypt's TFEC. While not overwhelming, this is significantly more than in many other Arab countries. Egypt is the Arab region's largest consumer of hydropower, accounting for around 50 percent of the entire region's consumption in 2016, and the second largest wind-power consumer after Morocco. Renewable energy makes a meaningful contribution to the electricity mix in Egypt, accounting for around 9 percent of total installed electricity-generation capacity, mostly in the form of hydropower. Egypt has world-class resources for harnessing wind energy at the Gulf of Suez, as well excellent solar resources suitable for both PV and CSP exploitation. A 2018 outlook by IRENA suggests Egypt's potential for renewable energy by 2029/2030 could lie at around 50.5 GW, up from 3.3 GW at the baseline 2009/2010, highlighting the vast scope for growth.[13] Egypt has also seen an increased uptake of solar home systems, with some 7,000 units installed in 2016, as well as use of solar mini-grids in some off-grid locations, for instance the 10 MW Masdar Siwa Project and the 125 kW Kalabsha village.[14]

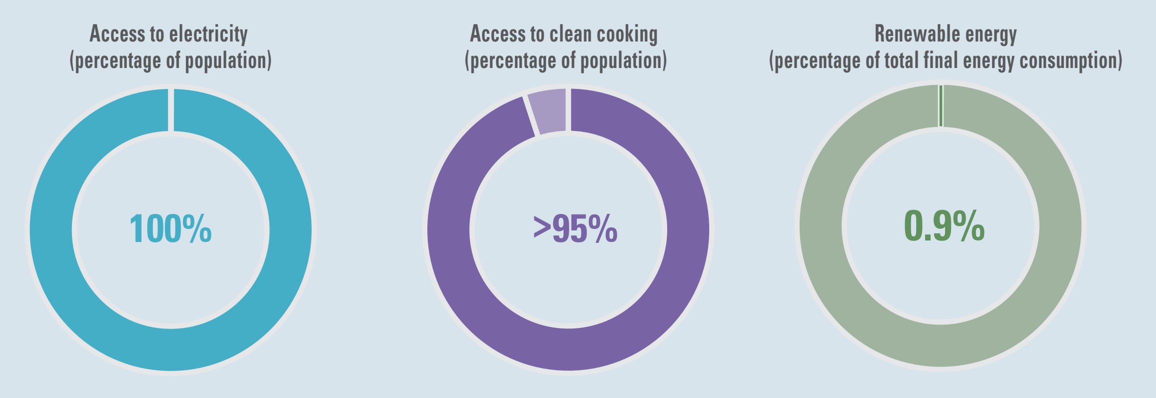
Energy efficiency

Egypt managed to decouple its primary energy supply from its economic growth during two distinct periods since 1990: from 1991 to 2004 and from 2009 to 2016. The trend in increasing energy use and declining intensity is associated with the challenging struggle to cope with high power-demand growth. Egypt's institutional energy efficiency framework has improved with the creation of a new energy efficiency unit within the Ministry of Electricity and Renewable Energy.

On the other hand, consumers have now more incentives to invest in energy efficiency with reduced subsidies for both electricity and fuel, as part of the Government's five-year plan to remove energy subsidies by 2020.[15] A new electricity law 87/2015 includes items related to improving energy efficiency.[16] In 2016, a three-year national awareness campaign for the rationalization of electricity consumption was launched. After the first NEEAP for 2012–2015 was launched, the Government developed a second NEEAP for 2018–2020, which targets 18 percent energy savings of projected energy consumption by 2035.[17]



Iraq



Energy access

Iraq's population saw near-universal access rates to electricity and CFTs during the 2010s, with high access rates as early as the 1990s. This success that official numbers suggest, however, does not reflect continuing problems across the Iraqi power sector, with acute worsening in the period 2014–2015 in consequence of initial advances made by Daesh. This includes frequent service disruptions to power supply.[18] The additional cost of neighbourhood generators incurred by households and businesses that help maintain a minimum level of service stability was estimated by the IEA in 2018 at up to USD 4 billion.[19] Similarly, Iraq's access to CFTs stood at >95 percent in 2017, though the data were unlikely to capture fully the unclear energy situation of around 277,000 Iraqi refugees and 2.6 million internally displaced people by the end of 2017,[20] and about whose energy supply there are no reliable data.

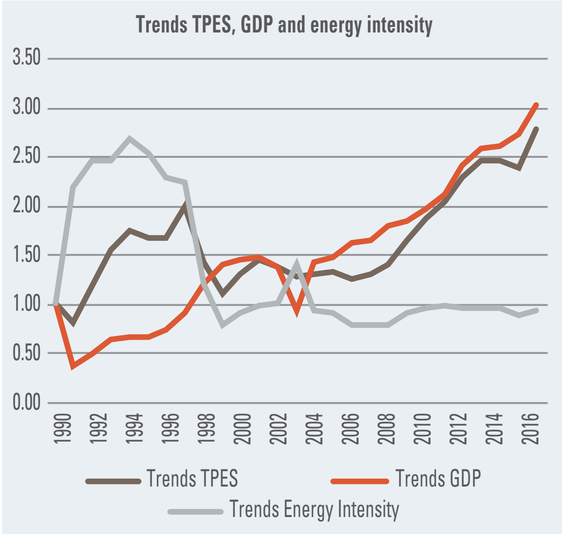
Renewable energy

At around 0.9 percent, renewable energy accounted for a negligible share of Iraq's TFEC in 2016. Hydropower used for electricity generation accounts for 80 percent of this, the remainder being solid biofuel used for heat raising. Consumption has been fluctuating considerably in recent years as a consequence of both conflict damage to infrastructure and climatic factors, to which hydropower is vulnerable. Iraq is the Arab region's third largest hydropower consumer, but has been lagging behind others in utilizing its renewable energy potential, in particular for solar power. Iraq has not yet seen the uptake of stand-alone solar rooftop systems as for instance in the State of Palestine and Yemen. In the absence of centrally driven, utility-size projects, this market segment could present considerable scope for growth in the future, given Iraq's power-sector challenges. Very low fuel and utility prices so far limit incentives for utilities and final consumers to switch, however.

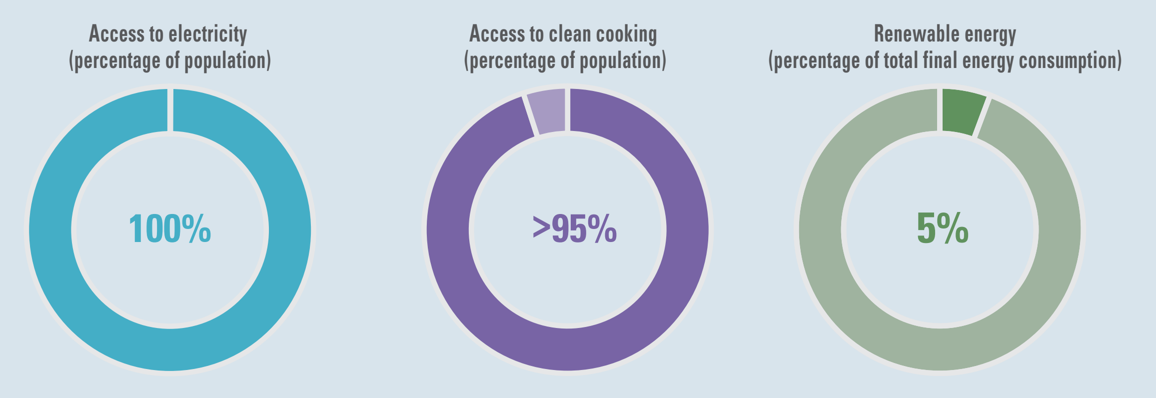
Energy efficiency

The tentative drop in energy demand and intensity in 2014–2015 fits with the internal disruptions in the economy. Energy efficiency regulations are needed to enforce the country's energy efficiency action plan where many policies are voluntary. Nevertheless, energy efficiency is starting to be considered a valuable component of Iraq's current energy strategies. The National Sustainable Development Plan 2018–2022 includes a number of sustainable energy objectives for the electricity sector such as improving the overall efficiency of the system and rationalizing the electrical consumption for different end users to reach a 7 percent reduction of energy consumption by 2022.[21] Other energy efficiency objectives are also indicated for the industrial, transport and building sectors in the INDC submitted by Iraq to the UNFCCC[22].

Sustained efforts and resources should be deployed to ensure the successful implementation of these objectives. Critical efforts are also needed to substantially reduce the important electric distribution losses, mainly non-technical, that are registered on the national grid. These losses amounted to more than 50 percent in 2016.



Jordan



Energy access

Jordan achieved virtually universal access to electricity in the early 2010s, with consistently high access rates throughout the 1990s and 2000s. Jordan's successful efforts in bringing electricity to last portions of unelectrified communities during the 2000s notably include the use of solar-based off-grid schemes, facilitated by a combination of institutional support and financed by the Rural Electrification Department in the Ministry of Energy and Mineral Resources.[23] Having absorbed several hundred thousands of refugees from neighbouring countries throughout the 2010s, Jordan has also been actively promoting safe, sustainable energy for refugees and Jordanians as part of its response plan to deal with the additional need for energy services caused by this massive inflow of refugees.[24] Jordan's CFT access in 2017 stood at above 95 percent, reflecting universal access to electricity, with 98 percent of the population using LPG for cooking.[25]

Renewable energy

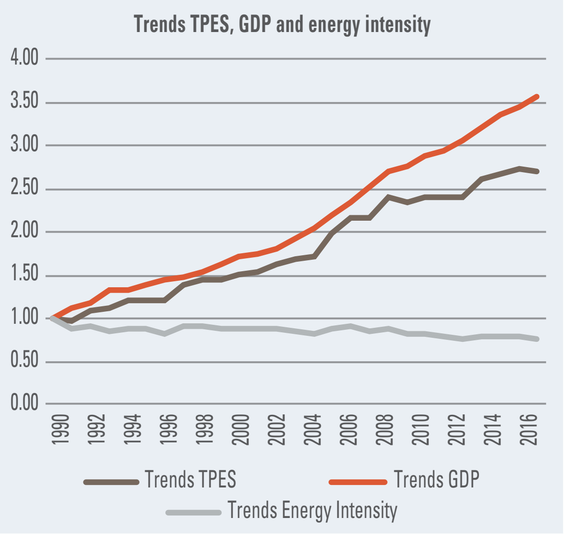
The share of renewable energy in Jordan's total primary energy supply stood at 5 percent in 2016, reflecting the country's continued high reliance on fossil fuel for an overwhelming share of its energy needs. Solar and wind power are the two dominant sources of renewable energy, mostly the result of efforts in recent years to increase the share of renewables in the country's energy in a bid to reduce reliance on costly fossil-fuel imports. Jordan imports all of its non-renewable energy sources, at significant cost to the state and—since energy subsidies were lifted for all fuels but LPG during the 2010s—final consumers. Jordan has ambitious plans to increase the share of renewable energy in its energy mix to 10 percent, and in electricity generation to 20 percent by 2020[26]. Current deployment rates suggest this target is likely to be met. Nevertheless, the local market has taken up solar and wind power at encouraging speed in recent years, making Jordan one of the Arab region's few countries in which the share of renewables in TFEC actually increased over the tracking period—a substantial share of which being driven by solar and wind energy. Data for 2016 suggest around 9 percent of the population in Jordan uses solar light systems,[27] with more than 200,000 solar home systems installed between 2014 and 2017 according to IRENA data.[28]

Energy efficiency

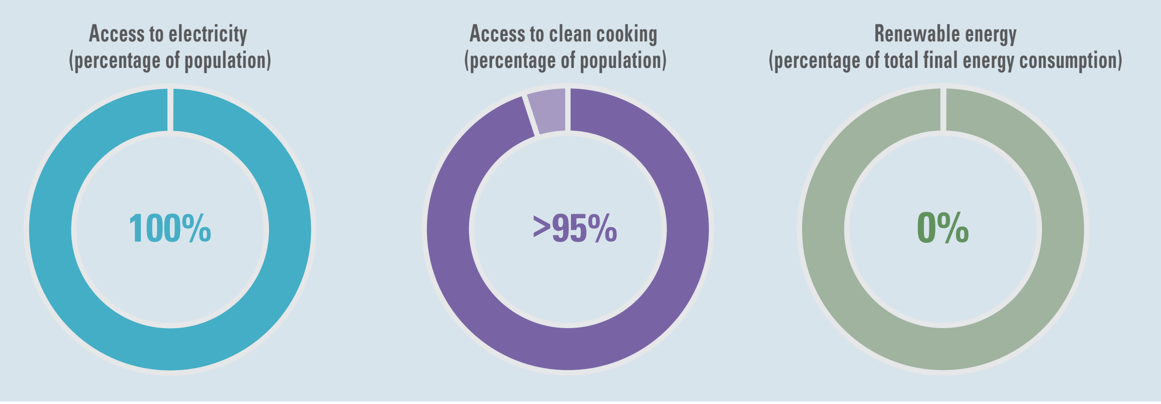
Jordan managed to decouple its economic growth from its energy consumption as early as 2000 and further deepened this process since 2008. This year was also the beginning of a substantial improvement in energy intensity as well. Since 2011, however, disruptions to the economy, as Jordan coped with a significant refugee influx, resulted in a disturbance of this improvement process with GHG emissions rising by 4 Mt in 2012.

In 2011, Jordan developed its first NEEAP, covering the period 2012–2014, which aimed at reducing the country's energy consumption by 7.1 percent by 2014.

A second NEEAP covering the period 2018–2020 was developed in November 2017 and included strategic goals for all sectors to reach an overall improvement of energy efficiency by 20 percent by 2020.[29] The second NEEAP aims to realize a 17.5 percent saving in electricity by 2020 (in comparison to annual average energy consumption during the period 2010–2014). Capacity has increased with new energy efficiency governing bodies and institutions, and a new Jordanian Renewable Energy and Energy Efficiency Fund (JREEEF) was established in 2015 to "Increase the use of RE and EE technologies by providing the necessary tailored financing to RE and RE projects and programmes".[30] Significant efforts in the power sector reform are enabling investment in new efficient and renewable capacity and offers an exemplar process and polices to neigbouring countries.



Kuwait



Energy access

As its GCC neighbours, Kuwait has been fully electrified and its population enjoyed complete access to CFTs well before the 1990s. A global oil exporter, Kuwait has among the world's highest per capita GDP levels, along with some of the lowest utility and wider energy prices in the world, making electricity and cooking fuels such as LPG universally affordable.

Renewable energy

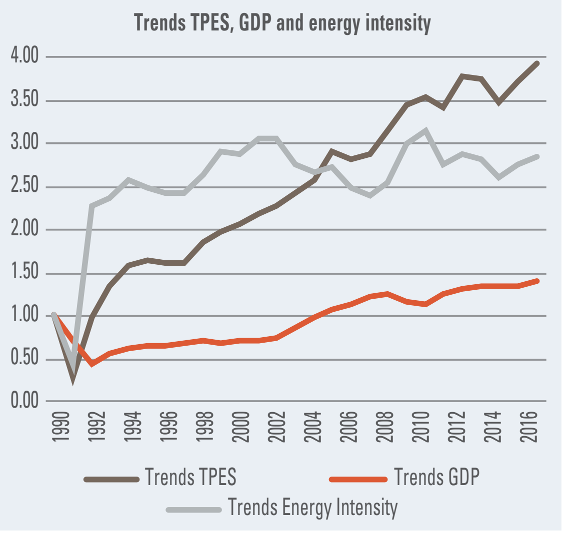
Renewable energy has historically played no role in Kuwait's energy mix, with virtually all the country's energy needs continuing to be met by oil and natural gas. Plans are for renewable energy to contribute 15 percent of electricity generation by 2030. By 2016, Kuwait had launched its most ambitious renewable energy project, so far: Shagaya, which includes 50 MW solar CSP, 10 MW solar PV and 10 MW wind power for use in electricity generation as a key demonstration project for the future economic use of renewable energy in the country.[31]

Energy efficiency

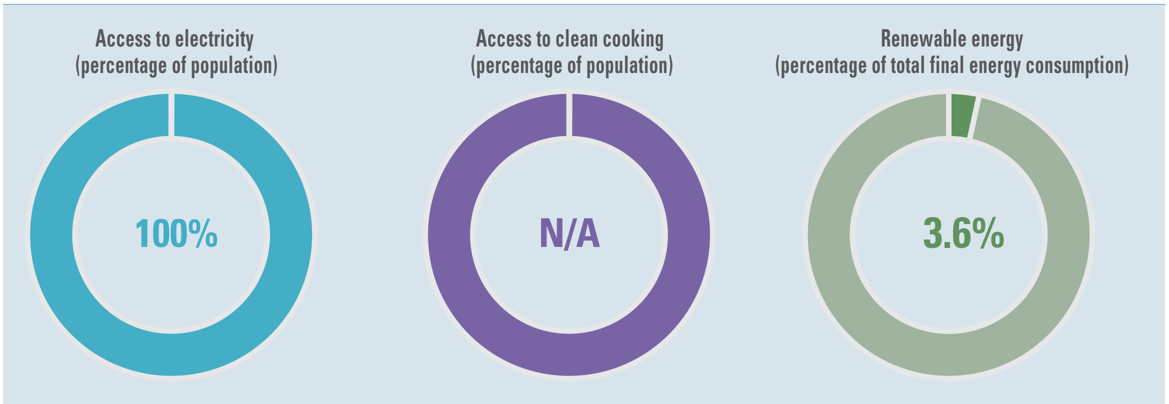
Long-term trends in both energy use and intensity climbed steadily in Kuwait until 2010, when energy intensity started to decline for five years from a high of 6 MJ/USD 2011 PPP. Energy demand and GDP continue to diverge, with primary energy supply increasing at a much higher rate than GDP during the 2014–2016 biennium.

Kuwait started increasing energy prices in 2016. The country is engaged in several energy efficiency programmes and has enforced a building energy performance code since 1983, with updates issued in 2010 and 2014.

The Ministry of Electricity and Water is cooperating with different stakeholders to conduct an energy-consumption rationalization campaign in the framework of the Tarsheed 1 programme, including with the Ministry of Education and other ministries and relevant sectors. The programme aims at promoting the rationalization of energy and water consumption as well as the importance of their preservation.[32, 33]



Lebanon



Energy access

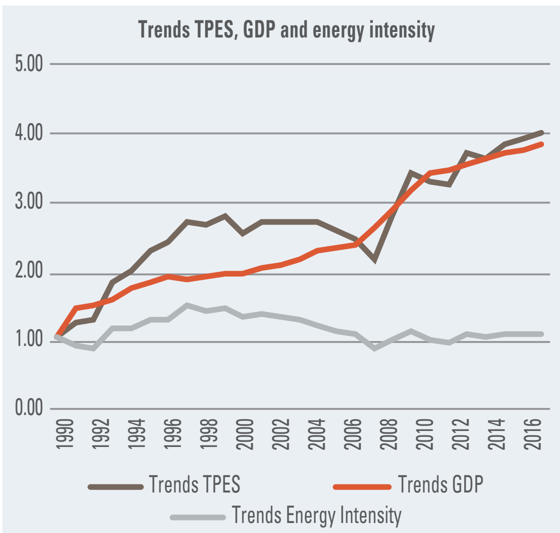
Electricity access stood at 100 percent in Lebanon in 2017. Despite universal electricity access, Lebanon's electricity sector is characterized by deteriorating and highly inadequate infrastructure that has resulted in poor reliability and inadequate levels of electricity supply for many year prior to the tracking period.[34] Power rationing and power failures have been frequent events for more than a decade, which has been further worsened by the considerable additional strain placed on Lebanon's already ailing power sector due to additional energy needs caused by the influx of over a million Syrian refugees since 2014.[35] No data for CFT access in Lebanon are available, but the situation in Lebanon makes it likely that access rates decreased as a result of more people using improvised cooking and heating fuels.

Renewable energy

Lebanon's renewable energy consumption as a share of TFEC has been steadily falling since the 1990s to 3.6 percent in 2016, reflecting declining use of solid biofuel to be replaced by electricity and liquid fuels. Growth during the tracking period in the off-grid, stand-alone solar market segment was encouraging. Between 2014 and 2016, solar-based electricity generation in Lebanon increased 4.5 times according to IRENA data.[36] PV-based electricity generation and water-heaters are an increasingly attractive alternative to diesel-based backup generators to help households cover chronic disruptions to power supply and reduce bills.[37] Lebanon's original target of 12 percent of the country's electricity and heat generation to be covered by renewables[38] was increased to 30 percent in 2018.[39]

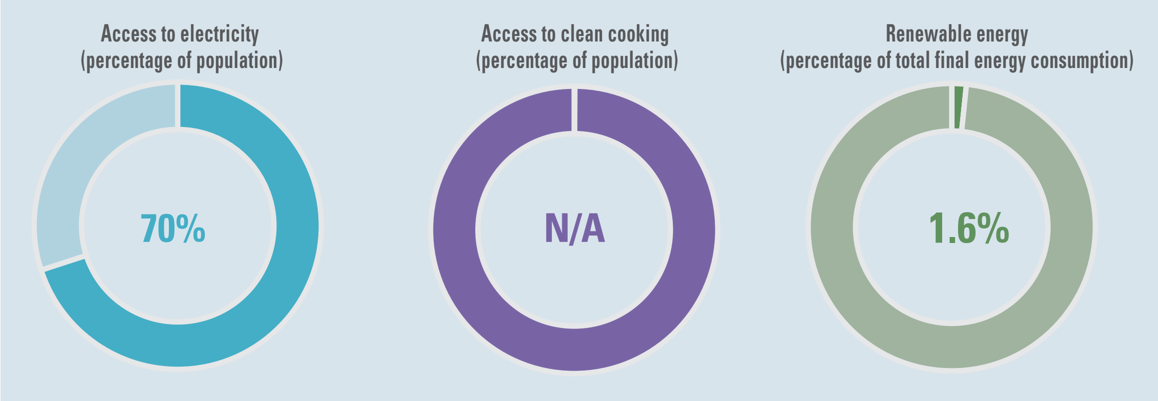
Energy efficiency

Energy intensity in Lebanon hovered around 3.3–4.3 MJ/USD 2011 PPP since 2005 to stabilize around 4–4.1 MJ/USD 2011 PPP since 2012. However, Lebanon has not yet managed to decouple its energy consumption from its economic development.



Nevertheless, Lebanon is making various efforts to improve its energy productivity by developing several energy efficiency programmes. These programmes were bundled in two NEEAPs covering the periods 2011–2015 and 2016–2020[40]. The second NEEAP builds on initiatives developed for the first one by focusing on 26 energy efficiency measures. These are expected to reduce power growth from 7 percent to 5.8 percent by 2020. Credit lines of interest-free loans, backed by the Lebanese Central Bank with the support of international donors[41, 42], play a key role in implementing these energy efficiency programmes for residential, commercial, non-profit and industrial customers.

Libya



Energy access

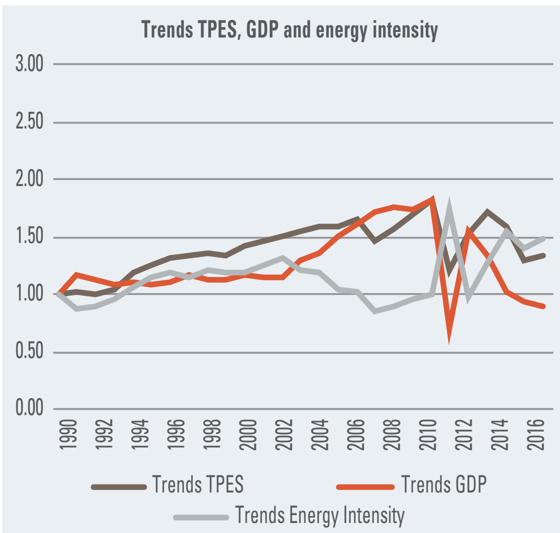
Libya is one of the Arab region's few countries whose near-universal electrification rate in the early 2000s declined in subsequent years. Libya's electrification rate of 70 percent in 2017 reflects, at the time of writing, the country's continuing state of internal conflict that has reversed previous decades' progress in making electricity access universal. No data are available for CFT access in Libya, but the ongoing domestic conflict, which, by 2017, had left some 165,000 people internally displaced[43], makes it likely that some people have experienced deteriorating access.

Renewable energy

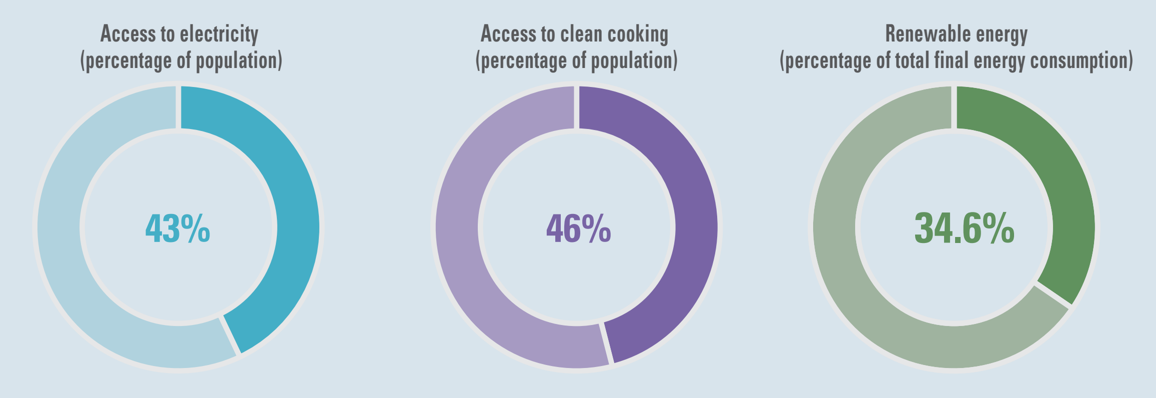
The share of renewable energy as part of Libya's TFEC has been declining steadily in recent decades, from a low 2 percent in 2000 to 1.6 percent in 2016. As in neighbouring countries, this reflects to a large extent the economy's move away from solid biofuel for heat raising towards liquid fuel and, in Libya's case, the absence of any modern renewable energy use, either in the power sector or for direct heat generation. The ongoing domestic conflict has barred the country from a more focused approach, with priority areas for policymaking currently being short- and medium-term solutions to the unfolding humanitarian problems the conflict entails.

Energy efficiency

Libya's energy intensity grew at a steady pace from 4.7 in 1990 to culminate at 6.22 MJ/USD 2011 PPP in 2002. During the period 2007–2010 GDP grew at a higher rate than TPES, indicating a tentative to decouple Libya's economic growth from its energy consumption. Energy intensity started to decline from 2002 until the 2011 revolution, when GDP halved and energy use dropped by a third. The civil conflict has also left Libya struggling with policy and institutional capacity to advance energy efficiency. Alongside some of the lowest energy prices in the region, substantial change will be required to power-sector policies to enable rebuilding and advance SDG goals. A high potential for energy efficiency and increasingly low-cost renewables highlights the need for new policy paradigms that enable rebuilding with much more sustainable distributed solutions.



Mauritania



Energy access

Mauritania is one of the poorest countries in the Arab region. In 2017, around 43 percent of the population had access to electricity, an encouraging improvement from 39 percent in 2014 and 34 percent in 2010. Difficulty of extending the national grid due to the highly scattered nature of demand means virtually all electricity access is concentrated in urban areas, where access is as high as 83 percent. Growth in access has been slow, at an annual rate of 3 percent, all of which comes from cities, while rural access has remained effectively unchanged with no formal access to electricity. Some rural communities benefit from mini-grids and self-generation, with no formal access data.[44] Conventional off-grid and mini-grid solutions based on diesel fuel are expensive, at an estimated average cost of USD 0.54/kWh in 2014 against USD 0.16/kWh for grid-based electricity.[45] Mauritania's CFT access rate in 2017 stood at around 46 percent, with few data about its composition.

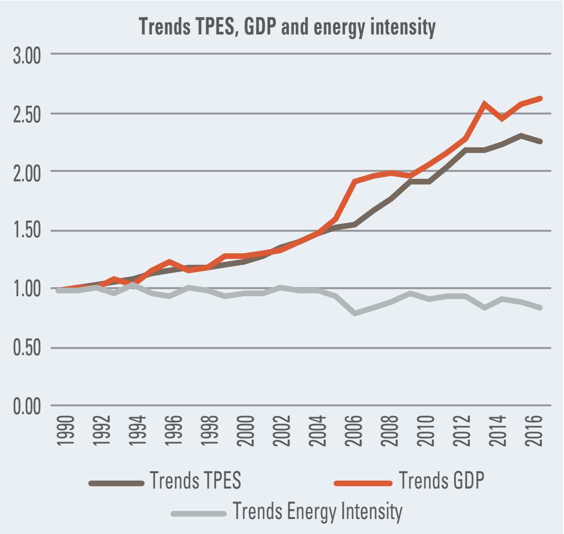
Renewable energy

The share of renewable energy in Mauritania's TFEC has been falling for many decades, in line with the decreasing use of traditional biomass and increased use of fossil fuels and electricity. With renewables accounting for around 35 percent of TFEC, Mauritania's energy mix is among the most reliant on renewable energy in the Arab region, albeit almost entirely based on solid biofuel. Mauritania has two main operational hydropower dams totalling 48 MW.[46] In 2013, Mauritania's first solar power plant, the 15 MW Sheikh Zayed Solar Power Plant in Nouakchotte, started operations, accounting for around 10 percent of Mauritania's grid capacity, and being at the time one of the biggest solar plants in Africa.[47] Since 2015, there have also been operational 34.4 MW wind-farm projects.[48] Solar and wind power also hold vast potential to help solve Mauritania's electricity-access gap by offering increasingly cost-effective solutions for scattered communities.

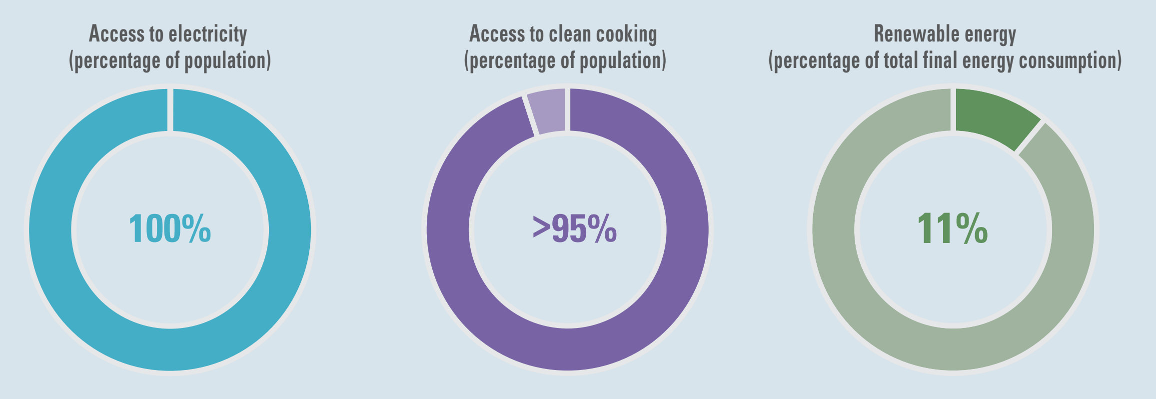
Energy efficiency

Between 1990 and 2005, Mauritania's energy intensity oscillated between 3.8 and 4.2 MJ/USD 2011 PPP. Then a mostly downward trend started, which reached 3.41 MJ/USD 2011 PPP in 2016. Starting from 2005, GDP grew at a higher rate than TPES, indicating a trend to decouple Mauritania's economic growth from its energy consumption. Mauritania has above-average energy prices, a key and often underestimated driver for rationalizing energy consumption, that in the absence of energy efficiency policies, must be assumed to be driving the slow decline in energy intensity.

A NEEAP under development offers opportunities to integrate energy efficiency with renewables policies so that future growth in demand is met by an economic and sustainable mix of energy efficiency and renewable energy.



Morocco



Energy access

Morocco achieved universal electricity access during the tracking period, being among the last Arab countries to close its access gap. The country's rural electrification programme (Programme d'Électrification Rurale Global, PERG), launched during the 1990s when electrification was below 50 percent, mainly in rural areas, resulted in a fast expansion of access over the years, reducing the access deficit to 30 percent by 2000 and eliminating it by 2015.[49] Morocco had a CFT access rate of above 95 percent in 2017.

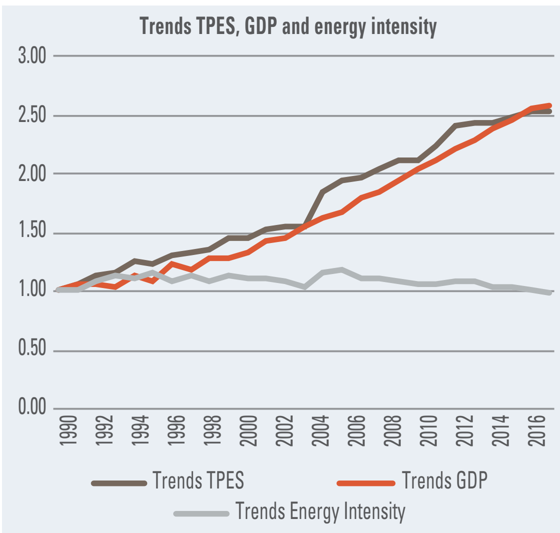
Renewable energy

Morocco's share of renewables as part of its TFEC in 2016 stood at 11 percent, having slightly declined since the 1990s on the back of falling solid-biofuel consumption. The country nevertheless is one of the Arab region's largest users of renewable energy, 76 percent of which is made up of solid biofuel. The remainder is accounted for by a growing share of other modern renewable energy technologies, in particular hydro, wind and solar power. Morocco is the Arab region's and one of Africa's largest producers of wind power, and is also a fast-growing solar thermal power producer that hosts one of the world's largest solar-power complexes, Noor Ouarzazate.[50]

Solar PV systems have also been an important contributing technology as part of Morocco's rural electrification programme in helping remote communities access electricity.[51] In 2015 alone, over 19,000 residential solar-lighting and solar home systems were installed, while solar water-pumps have found some use in agriculture and public water supply.[52]

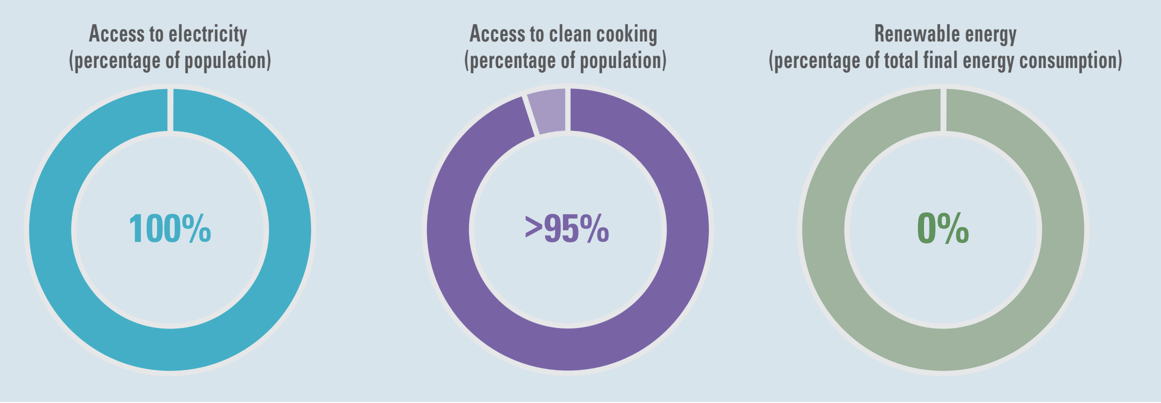
Energy efficiency

Since 1990, Morocco has maintained energy intensity around 3.1–3.5 MJ/USD 2011 PPP. From 2011, energy intensity took a downward path, starting at 3.46 MJ/USD 2011 PPP, to



reach a low 3.13 MJ/USD 2011 PPP. In Morocco, energy pricing, the highest fuel and industrial electricity prices in the region, and policies together drive energy efficiency progress. A financial tool entitled the Energy Development Fund was established to implement the country's strategy for developing renewable-energy and energy efficiency projects by 2020.[53] The national energy strategy aims to achieve 12 percent and 15 percent savings in energy consumption by 2020 and 2030, respectively.[54] While Morocco's National Energy Strategy Horizon 2030 sets energy efficiency goals and a legislative framework, by-laws still need to be implemented for the success of planned energy efficiency initiatives.[55]

Oman



Energy access

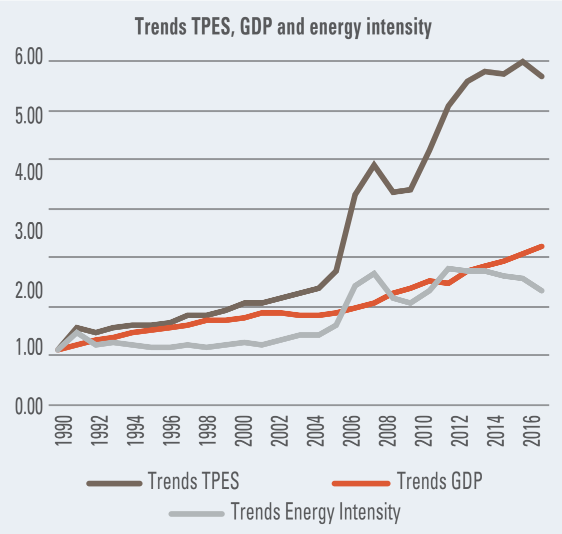
Oman has, like its GCC neighbours, been fully electrified and its population has enjoyed complete access to CFTs since well before the 1990s.

Renewable energy

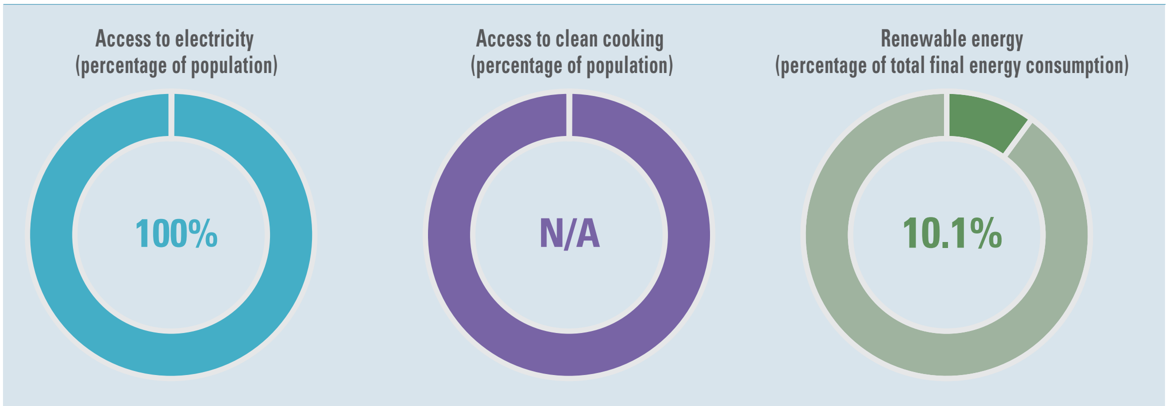
Renewable energy plays no role in Oman's energy mix, whose domestic energy needs are met entirely from oil and natural gas. During the tracking period, Oman gained valuable experience in solar-power enhanced oil recovery, being the first country in the region to use this technology. Other than that, several small-scale wind- and solar-power projects exist or are planned. Apart from solar potential, Oman has notably good wind resources.[56] In the regional context, Oman also stands out as having an unbundled electricity sector, providing potential future opportunities for more decentralized applications, which current initiative such as the Sahim scheme also target. Oman's current target is for renewable energy to account for 10 percent of electricity generation by 2025.[57]

Energy efficiency

Till 2005, Oman's energy intensity stayed below 4 MJ/USD 2011 PPP. In 2006, energy intensity jumped to 5.89 MJ/USD 2011 PPP and continued increasing to reach 6.76 MJ/USD 2011 PPP in 2011. It has since then dropped, reverting to 2006 intensity levels. From 2005, also, energy demand grew faster than GDP. Oman initiated a long-term energy efficiency strategy and a national energy action plan with specific energy efficiency measures, but lacks facilitating laws. Oman is developing an energy efficiency agency, ideally placed in its electricity regulatory authority. While Oman has a significant amount of work to do to improve the efficient use of energy, these upcoming changes point to an improvement in the country's energy efficiency planning.[58]



State of Palestine



Energy access

In 2017, access to electricity and CFTs in the State of Palestine was virtually universal. Electricity service quality, however, has been suffering from a severe, chronic shortage of power generation capacity, exacerbated by damage caused to its infrastructure and Gaza's sole power plant in consequence of years of conflict. Gaza is most affected: estimates suggest that about 1.8 million people live on less than 8 hours of electricity a day, and more than 60 percent of households are supplied with running water for 6–8 hours once every four days.[59] Electricity is expensive relative to income, with over 90 percent of the State of Palestine's electricity supply being imported from Israel at high cost.[60] Palestinians as a result pay more per KWh of electricity than almost anyone else in the Arab region, adding difficulty to many households in an already dire economic environment.[61]

Renewable energy

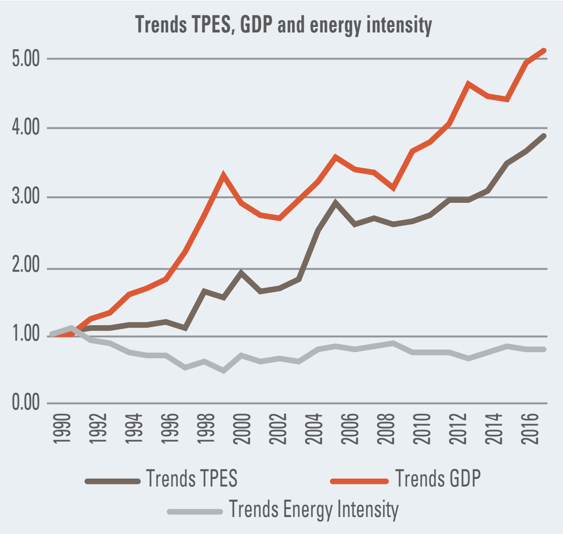
The State of Palestine has a comparably high share of renewables as part of its TFEC relative to the wider region: around 10 percent in 2016, 60 percent of which are based on solid biofuel, and 40 percent on solar power, all of which is used for heat raising. Solid biofuel used includes wood, charcoal and olive cake.[62] Expensive grid-based electricity and erratic service supply has increased incentives for private users to invest in stand-alone solar systems, although system costs still make solar technology products for higher-income market segments at the moment.[63] The potential to expand their use for further self-generation in the State of Palestine, however, is large, given the potential for future cost reductions, as well as strategic value in the technology's scope to reduce energy-import requirements from Israel. Further financing options could in the future help lower income households, as well as schools and other public buildings, increase the use of solar panels for self-generation, bridging times of power cuts and reducing overall grid consumption. The NREAP of the State of Palestine for 2030 has determined the target of renewable energy potential around 500 MW depends on access to Zone C, around 10 percent of electricity demand, while the West Bank could potentially meet 20 percent -30 percent of its energy needs from solar power by 2030.[64]

Energy efficiency

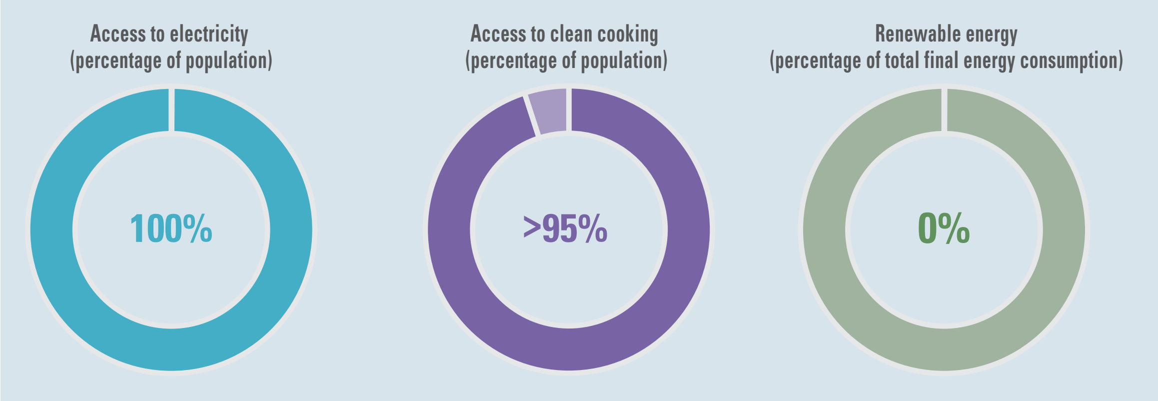
Low energy intensities in the State of Palestine are driven by the highest gasoline and electricity prices in the region, as well as constraints in energy supply. Furthermore, this situation induced a certain decoupling between GDP growth and energy consumption. The State of Palestine's NEEAP aims to achieve a 5 percent reduction in electricity consumption by 2020[65].

Financing instruments were developed to support these goals.

However, conflict-related disruptions to power systems put additional constraints on the system's operational efficiency, making it an ongoing challenge that is increasingly addressed by distributed renewables. Given these challenges, advancing both end-use efficiency and distributed renewables goes hand in hand in improving not only the attainment of SDG 7 but all SDGs.



Qatar



Energy access

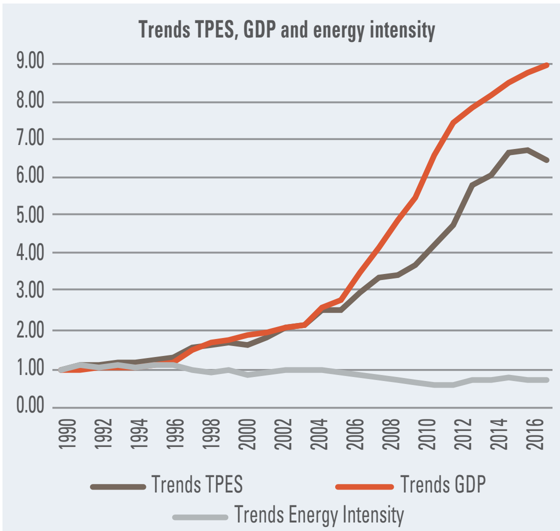
Qatar has been fully electrified and its population has enjoyed complete access to CFTs since well before the 1990s. With among the world's highest per capita GDP, a highly urbanized population, modern infrastructure and comparably low prices for electricity and water, modern utility services are universally affordable.

Renewable energy

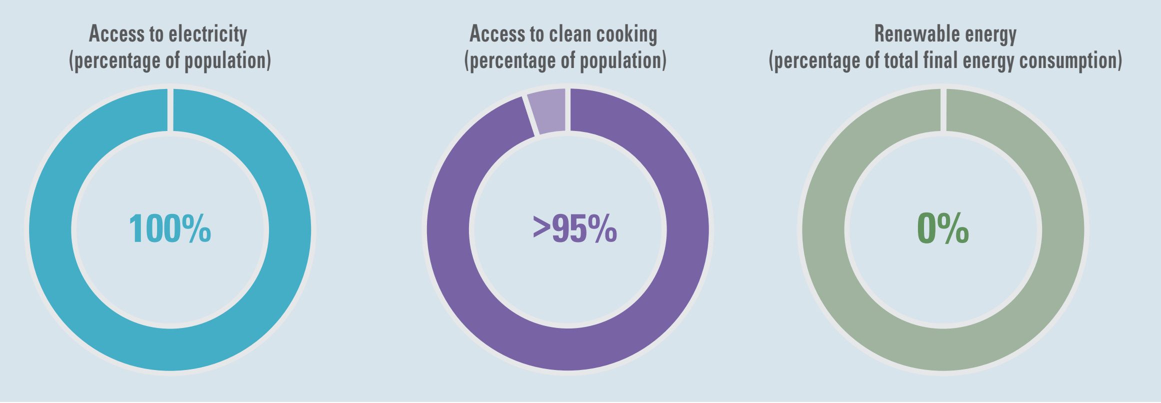
Renewable energy has historically played no role in Qatar's energy mix, with virtually all of the country's energy needs being met by natural gas and oil. Qatar uses only small amounts of solar power and has the GCC's only waste-to-energy plant. A target of 200–500 MW of solar power generation by 2020 has circulated in the media,[66] which would still leave renewable energy to be a negligible source of energy in the Qatari energy mix for the foreseeable future.

Energy efficiency

From 1990 to 2005, energy intensity in Qatar stayed above 7 MJ/USD 2011 PPP. In 2002, a solid declining energy intensity trend brought its level, in 2011, to 5.19 MJ/USD 2011 PPP. However, it went up again in subsequent years to around 6 MJ/USD 2011 PPP. Since 2005, GDP grew at a higher rate than energy consumption, indicating a decoupling tentative. Qatar has implemented a National Conservation and Energy Efficiency Programme Tarsheed (2012–2017). The country has also implemented several energy efficiency policies and regulations, including banning the import and sale of incandescent lights, promoting energy efficient lighting and establishing strong building energy efficiency regulations. (Qatar has the third largest number of Leadership in Energy and Environmental Design (LEED) certified buildings in the Arab region after Saudi Arabia and the United Arab Emirates). Qatar is also starting to address transport efficiency with planned public transport projects and railway connections to its GCC neighbours, which will reduce the country's carbon footprint and energy consumption across its transport sector. It is planned to reduce the electricity-consumption rate per capita by 25 percent by 2022.[67]



Saudi Arabia



Energy access

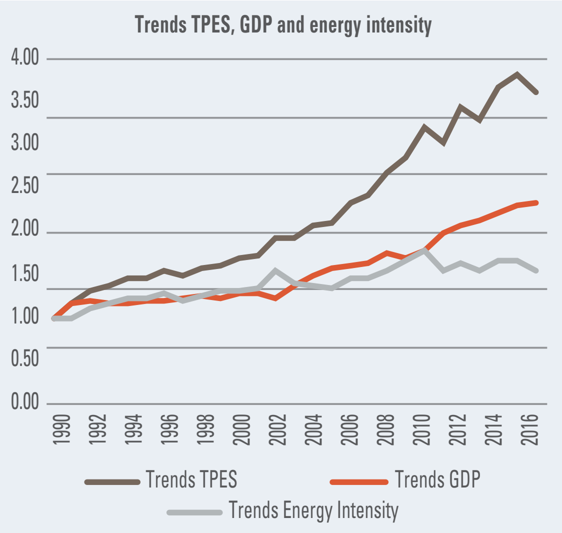
Like its GCC neighbours, Saudi Arabia has been fully electrified and its population has enjoyed complete access to CFTs since well before the 1990s.

Renewable energy

Renewable energy has historically played no role in Saudi Arabia's energy mix, with oil and gas supplying virtually all the country's energy needs. Saudi Arabia's economic reform drive since 2015, however, has seen the emergence of the National Renewable Energy Programme (launched in 2016) that forms part of Saudi Arabia's broader economic development and diversification plans. While current deployment is limited to a small number of demonstration projects, most of them based on solar PV, the Government indicated in 2016 that it was seeking to attract USD 30-50 billion of new investment in renewables in the period up to 2023, including from private sector sources that are encouraged to help drive the deployment of renewables.[68] In October 2017, the winning bid for one of the first Saudi auctions for solar PV at Sakaka was awarded at a price of 2.34 USD cents/kWh, a world record low, rendering solar PV cost-competitive with all alternative sources of energy in the country.[69] In January 2019, Saudi Arabia released a new, ambitious renewable energy target of 60 GW by 2030,[70] which would make one of the largest markets for renewable energy in the Arab region.

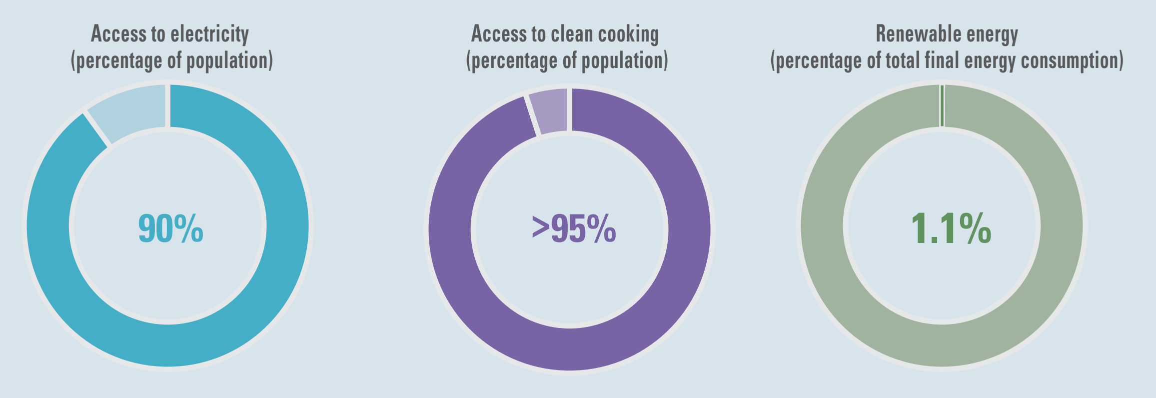
Energy efficiency

2010 saw a reversal of many years of growing energy intensity as Saudi Arabia started to address its persisting growth of energy consumption. Saudi Arabia is maintaining GDP growth as energy demand dropped in 2015. Its proficient National Energy Efficiency Programme and Saudi Energy Efficiency Centre lead a substantial implementation programme, but progress is impeded by some of the lowest energy prices in the region. This skewed policy



framework has been compensated for by recent developments of substantial programmes: CAFÉ standards for vehicles, the Tarshed Super-ESCO and substantial energy efficiency programmes within the country's large industrial enterprises to realize some of the energy sustainability ambition of Saudi Arabia's Vision 2030. The design, scale and economic potential of these programmes outlined in case studies in Chapters 2 and 4, can serve as regional exemplars. The Saudi Energy Efficiency Centre has developed an Energy Efficiency Action Plan to reduce electricity intensity by 30 percent by 2030, compared to 2005 levels, particularly in the construction, industrial and transportation sectors, which consume 90 percent of the country's energy.[71] The Saudi power sector has a significant stock of efficient CCGT and IWPP plants.

The Syrian Arab Republic



Energy access

The Syrian Arab Republic 's electrification rate in 2017 stood at 90 percent, a decline from universal electricity access during the mid-2000s. As in Libya, this is a step backwards in the country's development and reflects the devastating effects of years of intense conflict, reversing the progress of previous decades in just a few years. Conflict has caused severe damage to the energy sector, including oil and gas production, affecting electricity-generation capacity through lack of fuel, and infrastructure.[72] Those with access to electricity suffer from an erratic supply of electricity and water in many parts of the country as a result of damage to essential infrastructure, including power stations, transmission lines and fuel distribution lines.[73] Electricity supply is available for about 4–6 hours per day.[74] In addition, some 5.5 million Syrians were registered as refugees in 2017, while another 6.15 million people were internally displaced,[75] with no formal records about their energy situation. The considerable destruction of the country's energy infrastructure will likely be a long-term liability that will affect de facto access to modern energy and electricity-service quality in a post-conflict Syrian Arab Republic for many years to come.

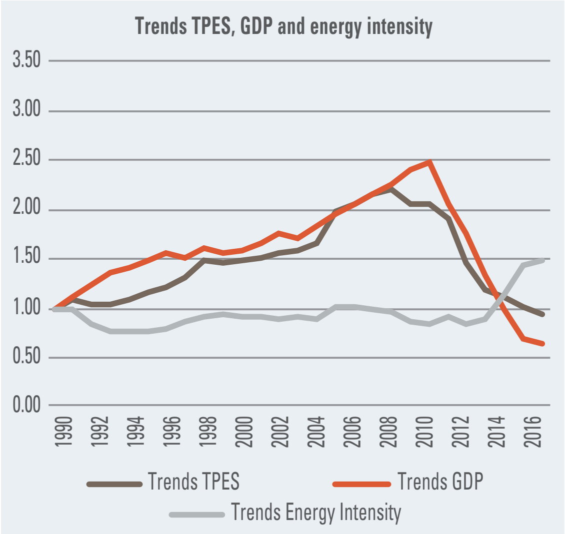
Renewable energy

Renewable energy contributed some 17.5 percent[76] to the Syrian Arab Republic's TFEC in 2016, most of it from traditional biomass and hydro-resources (2.3 percent hydropower[77]) that have been in use in the country for many decades. The share of the Syrian Arab Republic's renewable energy consumption as part of its TFEC has halved since 2000, the result of a declining share of hydropower and solid biofuel vis-à-vis fossil fuels. Because of the war, however, the Syrian population has increased its reliance on the consumption of fuelwood for heating and cooking purposes, which drove the consumption of traditional biomass to around 15 percent of the country's energy consumption in 2016.[78] The Syrian Arab Republic's conflict economy throughout the tracking period has not allowed the central Government to focus on policies designed to increase the share of renewables in its energy mix in the long term. During the conflict period, the Syrian Government has offered soft loans for solar water-heaters, with additional plans to equip public buildings with them, as well.[79] The Syrian Agricultural Bank has also started providing farmers with soft loans to install solar PV systems to power well-pumps, while the Government is currently establishing a renewable energy fund to support the use of renewables and raise energy efficiency.[80] The Syrian Arab Republic's eventual post-conflict economy holds potential for development-linked projects to target renewable-energy-based solutions both to help improve the country's energy situation in the years to come, and to contribute to the development of new industries and sustainable job opportunities for Syrians.

Energy efficiency

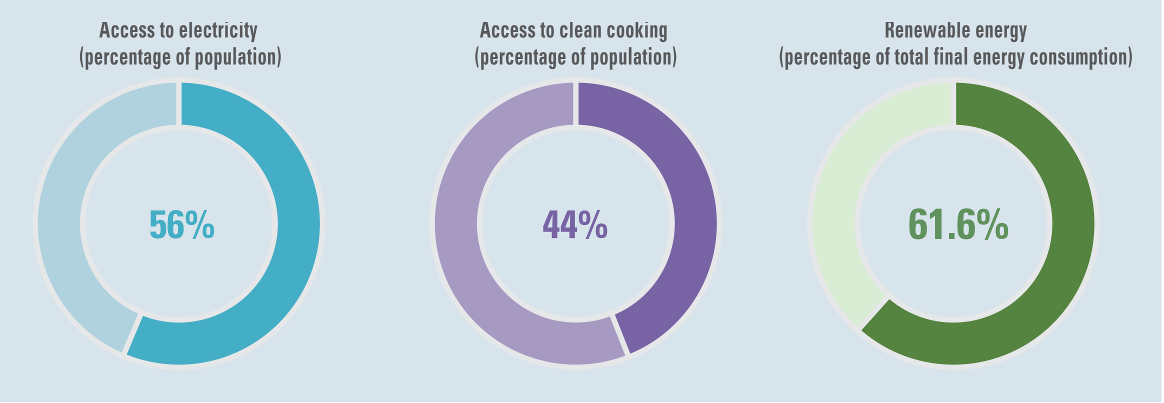
From 1990 to 2013, the Syrian Arab Republic's energy intensity fluctuated above 6.5 MJ/USD 2011 PPP, to peak around 8 MJ/USD 2011 PPP during certain years, with no clear long-term trend, except a five-year period when it was down to 6.1–6.2 MJ/USD 2011 PPP.

The national conflict led to a crumbling of the economy since 2011 with GDP and energy consumption falling in 2016 below their 1990s levels, with energy intensity reaching an all-time high of 11.81 MJ/USD 2011 PPP in 2016. The Syrian Arab Republic, however, has continued to reduce energy subsidies, increasing electricity and fuel prices for all types of consumers. As of January 2017, domestic electricity prices more than doubled from their 2014 values, whereas the industrial and commercial tariffs increased more than 5 times compared to their 2014 values.



The national 2030 strategy of the Ministry of Electricity comprises several goals, including reducing primary energy consumption by 10 percent by 2030.[81]

The Sudan



Energy access

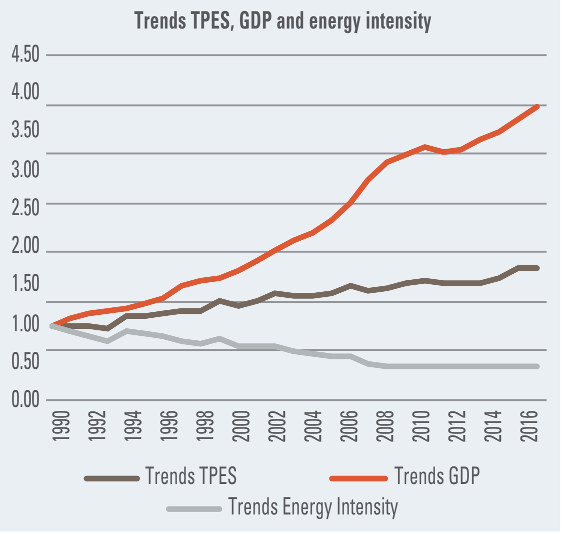
At 56 percent, the Sudan had one of the Arab region's lowest electrification rates in 2017 and accounts for the largest population without electricity access: around 17.69 million in 2017 or two-thirds of the region's total population without access. Rural access to electricity remains particularly precarious: 43 percent in 2017. Encouragingly, electricity access has been increasing steadily, at about 8 percent per annum during the tracking period for the total, and 14 percent per annum in rural areas. WHO's point estimate for access to CFTs stood at 44 percent in 2017 (30 percent at the lower-bound estimate), with the Sudan being one of the world's 20 largest CFT access-deficit countries.[82] The Sudanese Government's efforts at reducing its fiscal subsidy burden resulted in significant fuel and electricity price increases in November 2016[83], affecting affordability by low- and many middle-income households.

Renewable energy

The Sudan relies for around 62 percent of its TFEC on renewable energy, including hydro-resources: more than any other Arab country. Over 90 percent of its renewable-energy consumption is based on solid biofuel, most of which must be assumed to be traditional, with the remainder being derived from hydropower; again, some 90 percent of this is used for heat raising. The Sudan has not yet turned from being a large user of biomass for heating, lighting and cooking to one using its vast renewable-energy potential for electricity generation, beyond its hydro-resources.

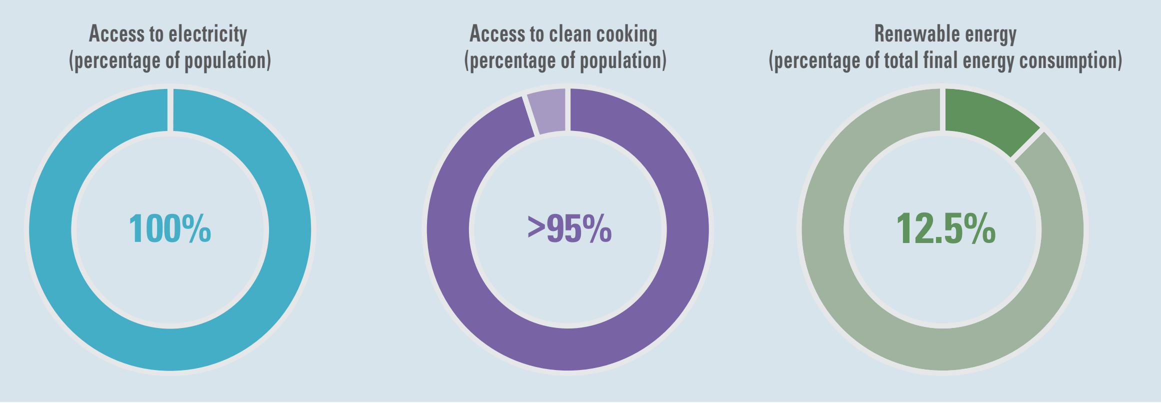
Energy efficiency

With a nearly 60 percent reduction in energy intensity from 1990 to 2010, the Sudan has made good progress in economic output with a much slower increase (40 percent) in energy demand. These trends indicate a clear decoupling of the country's economic growth from its energy consumption.



The Sudan's prepaid meter programme reduces non-technical power losses, improves bill collection and offers consumers direct price response incentives for energy savings. However, policy frameworks for sustainable energy need to be further improved. In 2016, the price of gasoline and diesel was raised and the implementation of the Sudan's first NEEAP came to an end in 2016. However, it is not clear if the planned energy savings, on the basis of 2013 (4.5 percent by 2016 and 24.6 percent by 2020), were properly evaluated. On 2 February 2017, the Council of Ministers approved NEEAP for the period 2017–2020 with the aim of achieving energy savings of about 15 percent of the total demand.[84]

Tunisia



Energy access

Tunisia has had universal access to electricity and CFTs since the 2000s. While access is widespread, Tunisians in 2017 paid the Arab region's highest price for electricity, following systematic reform efforts to eliminate electricity subsidies in previous years. Affordability hence is of concern for low- and lower-middle-income groups.

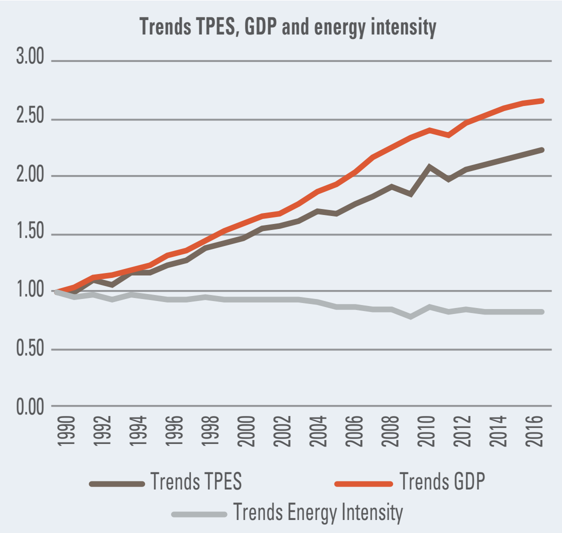
Renewable energy

Renewable energy accounted for around 12.5 percent of TFEC in Tunisia in 2016, positioning Tunisia among those few Arab countries where renewables contribute substantially to the national energy supply. The bulk of renewable energy consumption is based on solid biofuels used for heat raising, with a remaining small but rapidly increasing use of wind and solar energy for electricity generation.[85] In 2016, Tunisia was the Arab region's third largest consumer of wind power. Nonetheless, the overall share of renewables in TFEC has been falling since 2000, reflecting declining use of solid biofuel. The Tunisia Solar Plan (2012) targets 30 percent of electricity production by 2030 to be based on renewable energy[86] in line with the country's long-term strategy to diversify its fuel mix in power generation away from mostly imported fossil fuels. Tunisia has seen increased used of solar lighting and solar home systems in recent years, with some 3,500 units installed in 2016 alone, and some uptake of solar water pumps.[87]

Energy efficiency

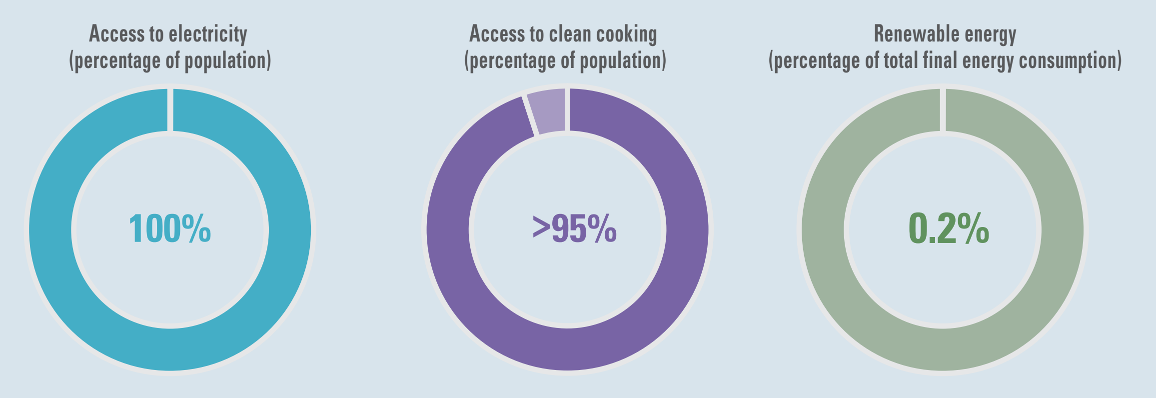
Advanced in terms of its mix of energy efficiency policies, institutional capacity and pricing, Tunisia's persisting reduction in energy intensity has slowed at a low 3.70 MJ/USD 2011 PPP to 3.79 MJ/USD 2011 PPP since 2011. However, the country has managed to decouple its economic growth from its energy consumption since 2003.

Residential electricity prices are among the highest in the region, but commercial and industrial prices, as well as fuel prices retain some subsidies.



A national energy strategy Energy 2030 and New Programme 2013–2020 are under implementation with mature regulations, implementation programmes and financial incentives to increase energy efficiency. An Energy Transition Fund was established in 2013[88] with implementation texts enforced in 2017 to promote investment in sustainable energy, helping to reinforce energy institutions and implement national programmes for sustainable energy projects.[89] The National Energy Sector Strategy 2030 aims at enhancing the national resources of fossil fuels and supporting energy independence. It has a global objective of reducing primary energy consumption by 30 percent by 2030, using 2010 as a baseline.

United Arab Emirates



Energy access

The United Arab Emirates has been fully electrified and its population has enjoyed complete access to CFTs since well before the 1990s. Low-cost electricity until recent years made electricity a very affordable good. Utility-pricing reform since the early 2010s in Dubai and Abu Dhabi[90] has increased significantly the cost of electricity to expatriates, who account for a majority of the population. Comparably high average per capita income levels, however, mean that electricity remains affordable. The United Arab Emirates is one of only a few Arab countries with a residential gas-pipeline supply network, meaning many residents use grid-based gas for cooking.

Renewable energy

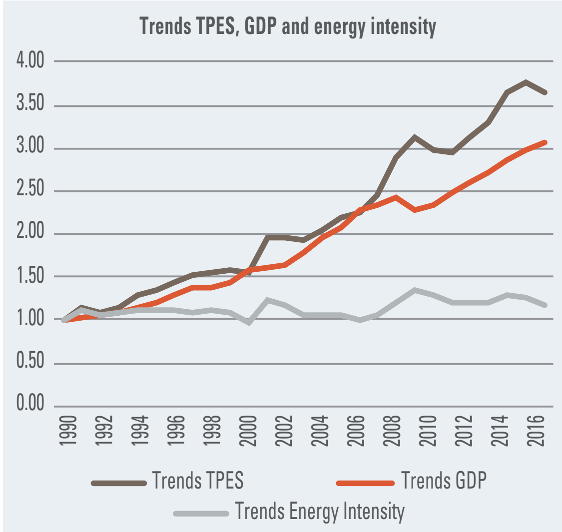
The share of renewable energy in the United Arab Emirates's TFEC remained low at 0.2 percent in 2016, yet the United Arab Emirates has in recent years become one of the most dynamic markets for the deployment of renewables in the Arab region. In 2017/2018, the country accounted for around two-thirds of installed renewable energy-generation capacity in the GCC, having quadrupled its renewables-based power-generation capacity between 2014 and 2017/18.[91] Solar power accounts for virtually all of this. The United Arab Emirates' auctions for new utility-scale solar projects in 2016 and 2017 resulted in record low bidding prices for solar PV and solar CSP, rendering solar PV cost-competitive with all other energy technologies in the utility sector.[92] The United Arab Emirates' renewable energy plans for the future are ambitious, with a target of 44 percent of power generation capacity by 2050 to be based on clean energy, including both renewables and nuclear power.[93]

Energy efficiency

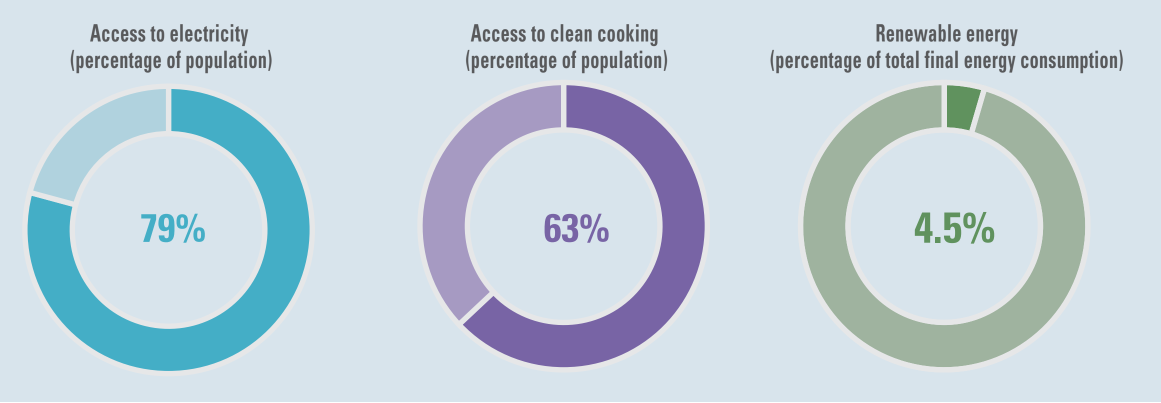
From 1990 to 2008, energy intensity fluctuated between 4.1 MJ/USD 2011 PPP and 5.1 MJ/USD 2011 PPP, with significant growth in energy demand. Energy intensity culminated in 2009 at 5.71 MJ/USD 2011 PPP and started a downward trend to reach, in 2016, 4.96 MJ/USD 2011 PPP.

Recent implementations of sustainable energy policies suggest an increasingly integrated approach: the Dubai Green Fund's AED 100 billion credit line for energy efficiency and renewable energy measures, with the reinforcement of building energy-performance regulation and promotion of its improvement being one of the main targets (United Arab Emirates has now the highest number of LEED-certified buildings in the region). The Dubai Green Fund was established to support the implementation of projects under the Energy Demand Management and Efficiency Strategy, including the rehabilitation of buildings and other water- and energy efficiency projects.[94]

The Supreme Energy Council of Dubai developed a strategy on energy-demand management, as part of the Dubai Integrated Energy Strategy 2030 and the Government of Dubai is committed to achieving 30 percent savings in energy and water consumption in eight programmes focusing on energy, water and transport.[95] On the other hand, Abu Dhabi's Comprehensive Cooling Plan targets a 15 percent energy demand reduction by 2020 from 2010. Furthermore, the Etihad Super-ESCO targets 1.7 TWh of electricity-demand reductions in more than 30,000 buildings by 2030. Electricity prices in the United Arab Emirates are above average and increased by more than 30 percent for nationals at the beginning of 2017. Gasoline and diesel prices remain relatively low but prices increased by around 20 percent in November 2016.



Yemen



Energy access

Yemen has among the lowest electrification rates in the Arab region at around 79 percent in 2017. Encouragingly, substantive growth in electricity access has further accelerated in recent years, rising by an average of 6.2 percent per year over the tracking period between 2014 and 2017. Based on available infrastructure, virtually all the access deficit is rurally based, although access increased steadily, with a fast rise of 10.7 percent annually between 2014 and 2017. Yemen's fragile political situation that followed the outbreak of political conflict in 2014, however, means that the country's actual electricity-supply situation does not match progress as suggested by official electricity-access numbers. By mid-2017, at the time of the World Bank's Yemen Dynamic Damage and Needs Assessment Phase II, public utility services had effectively collapsed, leaving six out of the 10 cities surveyed without electricity, and rural areas at pre-conflict electricity access rates of only 53 percent.[96]

Yemen's CFT access rate has been hovering around 63 percent, largely unchanged since the mid-2010s, though with a slight improvement compared with the beginning of the decade. Fuel shortages have also led to spiking prices for liquid fuels, further reducing the quality of fuel used in the absence of affordable alternatives to liquid fuels, with many women having reportedly resorted to cooking with plastic, which releases extremely harmful chemicals.[97]

Renewable energy

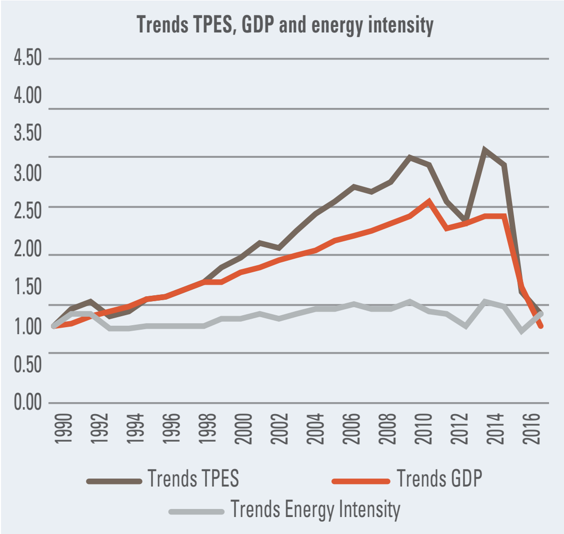
The share of renewable energy in Yemen's TFEC was 4.5 percent in 2016, of which solid biofuels—used primarily for heat generation—accounted for 2.5 percent, and solar power—used for electricity generation—for the remainder. The tracking period has notably seen the rapid spread of stand-alone solar rooftop systems to fill a gap in electricity services. A market assessment commissioned by the World Bank during 2016 estimates that as much as 75 percent of households in urban areas, including Sana'a, and 50 percent in rural areas use some form of solar power.[98] This success story in the midst of an otherwise dire power-sector situation suggests renewable energy, in particular solar power, has much potential to help Yemen restore lost energy access, while helping close the large gap in electricity access in rural areas, which existed already before the conflict.

Energy efficiency

Since 1990, Yemen's energy intensity grew slowly from 2.6 MJ/ USD 2011 PPP to 3.09 MJ/ USD 2011 PPP in 2010.

The country faced political instability in 2011 and by 2015 civil war had broken out. These drivers of change are reflected in the collapse of both energy supply and GDP trends.

Since 2014, energy prices have been above the regional average. Yemen is preparing its first NEEAP, which can help in setting up short-term energy efficiency goals and identifying energy efficiency programmes. Cabinet Decision No. 302/2010 on governmental actions requires progress in energy efficiency.[99] The development of appropriate energy efficiency policies and regulations, as well as the corresponding institutional frameworks, are essential to ensure the fulfilment of these requirements.



Conclusion

Achieving SDG 7 in the Arab region requires much more implementation and impact from policies than in the past. While substantial progress has been made in past decades in the areas of electrification and access to CFTs, large populations are still being left behind in the Arab LDCs. Furthermore, meeting SDG targets will require significantly scaled-up progress in integrating renewable energy into Arab countries' energy mix, and in decoupling regional growth from energy consumption through improved energy efficiency. SDG 7.2 and 7.3 concerning renewable energy and energy efficiency form a critical part of the region's response to climate change. But they can do so only once policy clarity is developed into implementation momentum, building new capacity, investment and technology markets for sustainable energy.

Integrating energy, climate and environmental goals more closely into socioeconomic development targets

Arab countries need to act urgently to elevate social well-being, sustainable energy and water services, and environmental sustainability to a development priority. Unsustainable energy use patterns, including energy access based on poor quality fuels and inefficient appliances, and inefficient energy-consumption patterns affect millions of people in the Arab region, their health, their education and their socioeconomic prospects. This is especially so for vulnerable people facing gender inequality, conflict and those in remote locations, where sustainable energy transition can be a just transition to new levels of equality and well-being. Lack of policy focus on sustainable energy as an integral part of countries' development agendas has meant renewable energy remains a niche technology in many Arab countries. Development of renewable energy in recent years has been driven more by individual small-scale projects and needs new policies to mandate state utilities to widely adopt and enable distributed low-cost renewables. The majority of Arab countries have not yet been able to harvest the comparably low-hanging fruit of energy efficiency savings, despite their energy efficiency policies. Energy efficiency policies need to be recast in terms of SDGs and implemented at scale to pursue SDG and country development ambitions. This will decouple economic growth from energy consumption and deliver well-being across other SDG targets.

The absence of policy focus and poor attention by countries on sustainability has led in many cases to dissatisfying results. These include underperforming or wasteful electricity and water services, wasteful energy consumption patterns and, in many cases, an increasingly expensive fuel mix that relies overwhelmingly on subsidies for non-renewable sources of energy but has inadequate revenues to improve service quality. This is despite the apparent low-cost advantage of renewable energy sources in many country contexts today. Added to this is substantial environmental damage to the very living spaces that are meant to nurture future generations' growth, and the growing awareness of climate risks to well-being in the region. In the future, these largely unaccounted costs will further escalate in the presence of the devastating consequences of climate change on a region as arid and coastally exposed as the Arab region. This situation requires urgent change to policymaking across the four pillars of sustainable energy: energy access, energy efficiency, renewable energy, and climate action—in addition to much improved environmental management.

Prospects: What does an SDG society and its energy systems look like?

A shift to electrification. Electrotechnologies have been central to most of the gains in well-being over the past decades and will continue to drive new levels of service quality from less energy. Technical advances in heat pumps, air conditioners, electric vehicles, appliances, lighting and power electronics have shifted.

Distributed renewable electricity dominates energy systems. Increasingly more cost-effective on a lifecycle basis than traditional fossil fuel power systems, renewable energy is already making up significant parts of new power plant investment in some countries. Projections show that even a 100 percent renewable global energy system meeting 1.5°C temperature targets could be cheaper than existing energy systems by 2050. Power grids change from distributing central generation to balancing and sharing distributed renewable electricity.

Low carbon productivity driven by consumer demand for sustainable products. Businesses are already being set low- or zero-carbon objectives. Previously high-carbon footprint products are being redesigned for much lower carbon content. This is driven by global consumer demand for low carbon products and services.

Increased well-being, worthwhile jobs, economic performance. Since the 2006 Stern Review, analysis continues to outline the micro- and macroeconomic outcomes from a sustainable low-carbon energy system. Well-being and equality outcomes are less well understood, but a growing number of examples show that well-being can equal or exceed the energy system cost improvements.

Ensuring policy outcomes and performance

Targets and policies alone do not translate into more sustainable energy consumption patterns. Lack of progress across different aspects of SDG 7 has demonstrated that targets set by governments across sectors—from energy access over renewable energy to energy efficiency and climate policy—are not enough in and of themselves. Formulating appropriate policies and creating a wider business-friendly environment in which markets, rather than individual government-directed projects drive structural change is one of the most fundamental challenges of all Arab countries. This includes the right mix within each national context of positive incentives, and effective enforceable regulation, to drive widespread implementation and outcomes in energy efficiency. Equally, state-run utilities need to be mandated to enable both public and private sector investment commensurate in distributed renewables.

Investments will need to be made. Governments are challenged to better understand the opportunities for their countries from the current and projected declining price trends for renewable energy and energy efficiency technologies. These provide governments with opportunities to displace naïve consumer energy subsidies with lower-cost, higher-quality services. Integration of sustainable energy programmes with wider socioeconomic policies, such as addressing income poverty and access to credit facilities, develops implementation capacity and is critical to the success of many of these policies.

Policy commitment and implementation success rest on credible institutions and effective mechanisms for monitoring and enforcement. Competent, credible institutions form the backbone of any policy success. Their critical role in monitoring, enforcing and helping shape policy, makes progress in building implementation capability particularly important for success across the Arab region's development goals, not only in energy. Institutions must be given the mandate to carry out their work effectively, be staffed by appropriately trained and paid professionals, and make it an integral part of their work to encourage and collect citizens' feedback on how policies affect people, businesses and ultimately the success of their underlying objectives. Strong institutions benefit from increased government focus on transparency and accountability, all aspects that form part and parcel of good governance practice that in itself deserves much greater focus in the Arab region than has been the case in the past.

Strengthening information quality: data and information, civil society and local markets

A shared understanding of a sustainable future. The prospects for a sustainable society based on SDGs is not well understood. While many have ambitions for a more sustainable world, most do not understand that the investments that achieve it offer better returns to society than past central-supply systems. Governments have a role in explaining that renewable energy is continuing to offer lower life-cycle cost power and energy efficiency offers superior services for less energy. Both deliver multiple benefits across other SDGs in well-being, equality, jobs, reduced climate and local environmental impacts.

Civil society and local markets play a fundamental role in deploying technology and bringing about change to energy use patterns, in particular the increased uptake of renewable energy and energy efficiency. The case of increased use of distributed solar systems in countries such as Jordan, the State of Palestine and Yemen demonstrates the enormous opportunities for private markets to drive technology deployment if they are being given the opportunity. This highlights the important role of governments as regulators and credit facilitators, rather than necessarily as central planners, providers and deployers of technology as this has been the case in the past.

Empowering society and local markets are an inexpensive but effective means of changing consumption behaviour. Improved consumer information, through more transparent data and information management, better consumer information, as well as changes to national utility sectors that obstruct private user incentives, is a comparably inexpensive but potentially effective way of assisting changing energy consumption patterns and driving the diversification of the national energy mix. Private sector capability and markets are also paramount to driving energy efficiency improvements. Examples of substantial business- and private sector implementation and outcomes in sustainable energy often contrast with poor outcomes and evaluation by governments. Greater reinforcement of the role of civil society institutions, such as consumer protection agencies, can play an important role in rooting more sustainable energy consumption patterns in society, while assisting the creation of more effective laws and regulations that serve the national interest.

Making finance available, rapidly expanding implementation. Existing investment in energy efficiency and renewable energy is such a small part of existing capital flows, that a substantial shift to sustainable energy investments represents a change of focus rather than a demand for more capital. Sufficient experience exists in energy efficiency and renewable energy technologies in the region and globally, to now rapidly expand investment in their implementation. Existing efforts at establishing super-ESCOs in the region demonstrate how to scale-up sustainable energy investment. By integrating technology and finance skills to up-scale investment and develop investor confidence, super-ESCOs are powerful drivers for rapidly growing implementation.

Awareness creation: improving communication, knowledge creation and public discourse

Arab countries have not yet succeeded in rooting energy and environmental sustainability in national development agendas. The Arab region lacks space for independent media, a context that in many cases prevents meaningful national debate over what is important for national progress in development. The resulting, often widespread lack of awareness of sustainable environmental and natural resource management of which energy forms an integral part is to the detriment of the very basis of building prosperous, resilient societies. Lack of effective public debate, informed by good quality information and credible media also constrains governments' ability to mobilize and engage citizens, businesses and industries in better practice, and contributes to the persistence of ineffective policy frameworks.

Knowledge creation and effective development action needs informed citizens and effective public debate. Informed, lively and critical national debate and access to information by all citizens is critical to achieving progress across development indicators, including in energy. Societies need to be able to evaluate whether current policies are working; whether they address the root problem, for instance income poverty in the case of access to modern energy, or affordability in the case of more energy efficient appliances. This is a call not only for governments and societies to integrate the interlinkages of energy with climate and the environment in the public discourse much more prominently than has been the case in the past in the Arab region, but also to maximize the space for public knowledge creation and awareness of available solutions.

Consultation, engagement and collaboration. Achieving SDG goals is a challenge for all in society, not just a task for governments to carry alone. Implementation can be best advanced through stakeholder engagement by drawing in and enabling business and household decision makers, social interest, religious and environmental interest groups in a "grassroots" engagement in shaping a more sustainable and just future. Children will bear the long-term benefits of a just and effective transition to SDGs and have a special role in shaping how policies advance SDG ambitions. The global "school strike for climate" movement and a growing number of cities declaring climate emergencies highlight a desire for affirmative action. Governments can enable this vast resource of citizens by engaging with them in consultation on SDG policies, enabling self-help community level programmes and developing collaborative programmes to advance renewable energy and energy efficiency in communities.

Review outcomes to develop effective policies and implementation. This report offers only limited insight into outcomes: the changes in productivity, well-being and environmental outcomes are difficult to report, simply because they are not often evaluated. Aggregate trends in energy offer little insight into the effectiveness of policies or the diverse outcomes that are produced by energy efficiency and renewable energy. Policy and programme developers need to actively track policy and programme impacts, to engage society in the changes that need to be made, redesign policies to work better, and learn how to accelerate implementation.

Annex: SDG 7 outcomes that contribute to 2019 focus SDGs.

In this annex, the relationship between SDG7 energy efficiency, renewable energy and improved access, and the outcomes and multiple benefits they deliver to the 2019 focus SDGs is developed. Figure 49 at the beginning of chapter 4 outlined the key relationships between SDG 7 and the 2019 focal SDGs via outcomes and multiple benefits. This annex highlights examples of outcomes from actual energy efficiency policies, programmes, and projections, from the Arab region that contribute to the 2019 focus SDGs. Some of the SDG targets are beyond the scope of this report, so this annex focuses on the 2019 review of focal SDGs: SDGs 4, 8, 10,13,16 and 17.

Table 6. SDG 7 Energy efficiency, renewable energy in transport

Policy & measure outcomes	SDG 7 direct benefits	Multiple benefits	2019 focal SDGs
Saudi Vehicle CAFÉ Standards from 2016 Improves fuel economy significantly as 7 million vehicles currently sold per year is forecast to grow to 20 million by 2030.	Saudi country fleet fuel economy expected to improve from 12 km/l to 19 km/l by 2025	Improved health from 28 percent fuel economy, reduced local emissions.	SDG 10—Reduce inequality
		Reduced travel costs enable mobility for the vulnerable	
	28 percent reduction in fuel economy rather than doubling fuel use.	Avoids a projected doubling of transport carbon emissions to 2030 by lowering fuel consumption	SDG 13 Climate actions
		Collaboration in global fuel economy standards processes	SDG 17 Partnerships to achieve goals
Egypt: Vehicle scrapping	28 percent fuel economy improvement achieved between scrapped and new vehicles	Local efficient car manufacture. 50 percent of new cars use local gas.	SDG 8 Decent work and economic growth
		Lower costs. Loans enable taxi drivers to invest.	SDG 10 Reduced inequality
		0.3MtCO_2 avoided from 2013-2017	SDG13 Climate Actions
Morocco's 2040 rail strategy PRM2040*		An extra 36 percent of population has access to rail, halving travel times on some routes	SDG 10 Reduced inequality
		300,000 jobs created	SDG8 Decent work and economic growth

Note: https://futuramobility.org/transport-and-mobility-in-the-arab-world/

Table 7. SDG 7 Energy efficiency, renewable energy in industry

Policy & measure outcomes	SDG 7 direct benefits	Multiple benefits	2019 focal SDGs
SABIC reducing 2010 energy, water and GHG baseline by 25 percent, material loss by 50 percent.	-7.6 percent energy intensity improvement	-8.8 percent water intensity, -35 percent material loss in 2017	SDG 8 Decent work and economic growth
		-9.3 percent of GHG intensity. Flaring reduced by 45 percent in 2017	SDG 13 Climate Actions
Saudi Aramco's, Converge® low carbon process.		New process absorbs 50 percent CO_2 and offers plastics at a third of the existing carbon footprint	SDG 13 Climate Actions

Table 8. SDG 7 Energy efficiency, renewable energy in buildings

Policy & measure	SDG 7 direct benefits	Multiple benefits	2019 focal SDGs
The estimated benefits of implementing large-scale retrofit programmes of energy efficiency achievable measures targeting all types of buildings across Arab region	85–470 TWh/yr electricity consumption avoided 13– 65 GW peak demand reduction	Significant new jobs in energy efficiency	SDG 8 Decent work and economic growth
		Improved health for vulnerable through better living conditions	SDG 10 Reduced inequality
		Health risks avoided through maintaining safe indoor temperatures	
		Increased access to efficient energy services (not just connections) especially in remote communities	
		26–146 $MtCO_2$ direct carbon reduction from lowered electricity consumption	SDG 13 Climate actions
		Upstream benefits to utilities could be 140 percent of investment in consumer energy efficiency (US experience)	SDG 17 Partnerships to achieve goals
The estimated benefits of implementing large-scale retrofit programme of energy efficiency measures in Saudi Arabia USD 10-207 billion investment	16–100 TWh/yr electricity consumption avoided valued at USD 0.5-3 billion/year. 3.7–23 GW peak demand reduction valued at USD 2.8–17 billion/year	Job creation. 12,000–247,000 jobs per year in Saudi Arabia	SDG 8 Decent work and economic growth
		1.2–7.5 energy subsidies per year avoided	SDG 10 Reduced inequality
		12–247 $MtCO_2$/year direct carbon reductions	SDG 13 Climate actions
The estimated benefits of integrated building energy efficiency codes implemented across all buildings in the Arab region	12.7 TWh/yr energy consumption avoided 2 GW peak demand avoided	Job creation	SDG 8 Decent work and economic growth
		Improved access to energy services, improved health	SDG 10 Reduced inequality
		3.9 $MtCO_2$/year in avoided emissions	SDG 13 Climate actions

Policy & measure	SDG 7 direct benefits	Multiple benefits	2019 focal SDGs
The estimated benefits of integrated renewable energy on New Zero Energy Buildings (NZEB). USD 91 billion cost in Saudi Arabia, USD 25 billion in Tunisia, based on USD 2,500 per NZEB.	229TWh distributed renewable electricity by 2040, 458TWh by 2050. 38 GW distributed renewable electricity capacity by 2040	Job creation in sustainability	SDG 8 Decent work and economic growth
		Access to sustainable energy services	SDG 10 Reduced inequality
		29 $MtCO_2$ emissions avoided	SDG 13 Climate actions
		Renewable energy integrated in new buildings, lower costs	SDG 17 Partnerships to achieve goals
The estimated benefits of building code envelope thermal efficiency for those countries with no codes before 2014	1.8 TWh/yr consumption avoided 324 MW demand avoided	Jobs in building sector	SDG 8 Decent work and economic growth
		Improved health and safety from avoiding temperature extremes	SDG 10 Reduced inequality
		0.56 Mt/yr CO_2 emissions avoided	SDG 13 Climate actions
PV systems on entire existing residential building stock in Saudi Arabia, 221 million m^2 70 million m^2 in Tunisia	38 GW, 51 TWh/yr Saudi Arabia 10.5 GW 15 TWh/yr Tunisia	Job creation	SDG 8 Decent work and economic growth
		Increased access to energy services (not just electricity connections) especially in remote communities.	SDG 10 Reduced inequality
		29.2$MtCO_2$ avoided in Saudi Arabia 7.2$MtCO_2$ avoided in Tunisia	SDG 13 Climate actions
Integrated control LED in commercial buildings across Arab region	21 TWh year in 2030 14 GW peak demand reduction in 2030	11 $MtCO_2$ /year emissions avoided	SDG 13 Climate actions
Improved lighting, refrigerator and air conditioner MEPS	227 TWh lighting, 76.5 TWh refrigerators 67 TWh air conditioners, cumulative 2020–2030	144 $MtCO_2$ lighting 46 $MtCO_2$ refrigerators 41 $MtCO_2$ air conditioners, cumulative 2020–2030	SDG 13 Climate actions
Lighting MEPS across Arab Region	26 TWh/yr worth USD 1.5 billion/yr, avoided by 2030	19 $MtCO_2$ emissions avoided	SDG 13 Climate actions
Refrigerator MEPS across Arab region	13.8 TWh/yr worth USD 0.7 billion/yr, avoided by 2030	8.7 $MtCO_2$ emissions avoided	SDG 13 Climate actions
Improved air conditioner MEPS across Arab region	11 TWh/yr electricity avoided by 2030	Health risks avoided through maintaining safe indoor temperatures	SDG 10 Reduced inequality
		7.0 $MtCO_2$ emissions avoided	SDG 13 Climate actions
Improve knowledge of energy consumption patterns in buildings. Systematic statistical data collection of end-use consumption patterns. Monitor relevant energy performance indicators			SDG 17 Partnerships to achieve goals

Source: ESCWA 2018.

Table 9. SDG 7 Cross-sectoral policies and measures

Changes to policies and pricing have diverse impacts, depending on development status, economic cycles and policy features and are crucial to outcomes in other sectors. Three examples below show countries tempering fuel subsidy reductions with targeted social and sector payments.

Policy & measure outcomes	SDG 7 direct benefits	Multiple benefits	2019 focal SDGs
Jordan's electricity tariffs raised 15 percent in 2014 and 2105. 50 percent of 2015 increase repealed. Cash transfers to 70 percent of households below income threshold, if oil price >USD 100 per barrel.	Not assessed	Economically rationalizes energy value chains	SDG 8 Decent work and economic growth
		Impact on vulnerable and low income mitigated with targeted social support	SDG 10 Reduce inequality
		Carbon reduction from rationalized electricity and fuel consumption not assessed	SDG 13 Climate Actions
Tunisia's electricity tariffs increased 7 percent in 2012, then electricity and gas by 10 percent in January 2014 and May 2014. "Lifeline" tariff introduced for households using less than 100 kWh per month.	Not assessed	Economically rationalizes energy value chains	SDG 8 Decent work and economic growth
		Impact on vulnerable households mitigated by targeted tariff	SDG 10 Reduced inequality
		Carbon reduction from rationalized electricity and fuel consumption not assessed	SDG 13 Climate actions
Morocco. Removal of fuel subsidies for electricity generation. Transfers to electricity companies for 4 years allow adjustment while holding financial viability.	Not assessed	Economically rationalizes energy value chains for electricity	SDG 8 Decent work and economic growth
		Carbon reduction from stimulus for fuel efficiency	SDG 13 Climate actions
		Government and industry collaboration to manage change	SDG 17 Partnerships to achieve goals
Modelling net benefits of shift to market prices in Kuwait *		Net benefit of moving to market prices is 6.3 percent of GDP	SDG 10 Reduced inequality

Sources: IMF 2014. IEA 2015. *Fattouh, B and L. Mahadeva (2014)

About the data used in this report

Country group definitions

In this report, the Arab region[1] has been divided into four subregions, to help facilitate subregional analysis along the very different types of economies within the Arab region.

Table 10. Subregional groups and countries in the Arab region, 2017

Country	Population (million)	Population density (people per km² of land area)	Population in largest city (million)	GDP per capita, PPP (current international USD)
Maghreb				
Algeria	41.3	17.3	2.7	15,260
Libya	6.4	3.6	1.1	19,631
Morocco	35.7	80.1	3.7	8,217
Tunisia	11.5	74.2	2.3	11,911
Mashreq				
Egypt	97.6	98.0	19.6	11,584
Iraq	38.3	88.2	6.7	16,899
Jordan	9.7	109.3	2.0	9,153
Lebanon	6.1	594.6	2.3	14,482
Syrian Arab Republic	18.3	99.5	2.3	..
State of Palestine*	4.7	778.2	0.7	4,885
GCC				
Bahrain	1.5	1918.5	0.5	47,527
Kuwait	4.1	232.1	2.8	71,943
Oman	4.6	15.0	1.4	41,675
Qatar	2.6	227.3	0.7	128,374
Saudi Arabia	32.9	15.3	6.7	53,779
United Arab Emirates	9.4	132.4	2.7	73,878
Arab LDCs				
Mauritania	4.4	4.3	1.2	3,950
The Sudan	40.5	23.3	5.4	4,904
Yemen	28.3	53.5	2.7	2,601

Source: World Bank, 2019b

Chapter 1: Access to energy

a. Measuring access to electricity

This report relies on a combination of data sources for its analysis. The World Bank's Global Electrification Database compiles nationally representative household survey data and, occasionally, census data on electricity access, from sources going back to 1990. The database also incorporates data from the Socio-Economic Database for Latin America and the Caribbean, the Middle East and North Africa Poverty Database, and the Europe and Central Asia Poverty Database, which are based on similar surveys.[2]

The typical frequency of surveys is every two to three years but, in many countries, in and outside the Arab region, surveys are irregular in timing and much less frequent. To estimate missing values, a multilevel nonparametric modelling approach—developed by the World Health Organization for estimating clean fuel use—was adapted to electricity access and used to fill in the missing data points for 1990–2017. Where data are available, access estimates are weighted by population. Multilevel non-parametric modelling takes into account the hierarchical structure of data (country and regional levels).[3]

In order to use as much real data as possible, results based on real survey data are reported in their original form for all years available. The statistical model is used to fill in data only for years where they are missing and to conduct global and regional analyses.[4] The Arab region has large deficits in data availability, which implies the need for more modelling based on fewer data points. Many of the region's data points are hence the best approximation based on data provided by countries themselves.

Modelling data points for missing years at times of conflict is particularly challenging, not only because of a frequent lack of information to verify results, but also because conflict damage to infrastructure is intrinsically difficult to take into consideration in modelling exercises. Furthermore, the devastating effect of political instability on electricity service quality can leave electricity access data seem at odds with the reality on the ground. This problem has been encountered in several Arab countries, for instance in Yemen, where several cities have been left effectively without electricity since 2014[5] until the time of writing, while our data suggest a 98 percent electrification rate for urban areas.

Electricity access is defined under most underlying surveys as a household connection to electricity supply.[6] The presence of such a connection says nothing about service quality, reliability or affordability, an important caveat when interpreting electricity access data. Households are hence considered to have access to electricity, even if electricity supply is only available for a few hours per day, including off-grid solutions. In Yemen, access to electricity in some cities relies for decentralized solutions (i.e. self-generation through either solar-based systems or diesel generators) for virtually all their electricity supply. At the same time, we have no information about the proportion of decentralized electricity systems in key deficit countries Mauritania and the Sudan, making the statistical comparison between these countries problematic. Mauritania's rural electrification rate fell to 0 percent for 2017, down from 4 percent in 2014 in the 2017 tracking report, which is the result of modelling. Insufficient survey data means current work has to use the available data, despite its imperfections. Countries considered "developed" by the United Nations and classified as high income, on the other hand, are assumed to have an electrification rate of 100 percent from the first year the country entered the category.

b. Measuring access to CFTs

For the proportion of the population without clean cooking access, the main source in this report is WHO's Household Energy Database. The database is a regularly updated collection of nationally representative household survey data from various sources, which form the input basis for WHO's modelling approach. The database uses a multilevel non-parametric modelling approach developed by WHO, which takes into account the hierarchical structure of the data.[7]

To enable direct comparability with previous estimates, the same model used for the 2016 results was used to calculate the proportion of people relying on clean fuels for 2017. An updated version of the previous model was used to estimate the proportion of people relying on individual fuels for cooking in each country. In this case, the model estimates trends in the use of eight individual fuels (charcoal, coal, crop waste, dung, electricity, gas, kerosene and wood). It also includes corrections to overcome the sampling bias in the proportion of urban and rural survey respondents and missing total number of survey respondents. [8]

As in the case of electricity, the model is applied for all countries with at least one data point. In the Arab region, no data points were available for Lebanon and Libya, nor for the State of Palestine. State of Palestine values were separately supplied for the purposes of this report directly by the Palestinian Central Bureau of Statistics, while progress in access to CFTs could not be tracked for Lebanon and Libya, given current data deficits.

No data for CFT access are available for 2014 because of data constraints. This means that the tracking period for CFTs for this report has had to be 2015–2017 rather than 2014–2017. Moreover, CFT data were available only for specific year points, in this report for 2000, 2005, 2010, 2015, 2016, 2017. This makes time series analysis more difficult. Several countries also questioned the validity of modelled data, suggesting the results presented in this report are overestimating actual access rates. These concerns were raised by Iraq, the Sudan and Yemen.

Chapter 2: Energy efficiency

Energy intensity. The main global indicator for SDG 7.3 (energy efficiency at global, regional and country levels) is primary energy intensity (PEI). This is the ratio of total primary energy supply (TPES) to GDP and is measured in MJ/USD 2011 PPP.

$$PEI = \frac{TPES}{GDP}$$

Energy intensity indicates how much energy is used to produce a unit of economic output. A lower ratio indicates that less energy is used to produce a unit of economic output. Energy intensity is an imperfect indicator of energy efficiency as changes are impacted by other factors, particularly changes in the structure of economic activity.[9]

The key indicator of change in energy intensity is the average annual rate of improvement in PEI (percent). This is calculated as compound annual growth rate (CAGR), where:

$$CAGR = \left(\left(\frac{PEI_{t2}}{PEI_{t1}}\right)e^{\frac{1}{(t_2-t_1)}}\right) - 1$$

PEI_{t2} is primary energy intensity in year t2

PEI_{t1} is primary energy intensity in year t1

Negative values represent decreases (or improvements) in energy intensity (less energy is used to produce one unit of economic output or per unit of activity), while positive numbers indicate increases in energy intensity (more energy is used to produce one unit of economic output or per unit of activity).[10]

Total primary energy supply is measured in megajoules (MJ). Defined by the International Recommendations for Energy Statistics (IRES), it is made up of production plus net imports minus international marine and aviation bunkers plus-stock changes. Data sources: total energy supply is typically calculated in the making of national energy balances. Energy balances are compiled based on data collected for around 150 economies from the IEA and for all countries in the world from the UNSD.[11]

Gross domestic product (GDP) is measured in USD 2011 purchasing power parity (PPP). This is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. This is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. GDP is measured in USD 2011 PPP. Purchasing power parities are the rates of currency conversion that equalize the purchasing power of different currencies by eliminating the differences in price levels between countries. In their simplest form, PPPs are simply relative prices which show the ratio of the prices in national currencies of the same goods or services in different countries. Data source: World Bank's World Development Indicators.[12]

Energy intensity within country sectors. Primary energy resources are distributed within countries as final (or commercial) energy product after they have been transformed from primary resources into consumer products: generated electricity, refined diesel, petrol, processed gas and LPG.

Total final energy consumption (TFEC) is the sum of consumption of the final energy products in MJ across different end-use sectors, excluding non-energy uses of fuels. TFEC is broken down into energy demand in the following sectors: industry, transport, residential, services, agriculture and others. It excludes international marine and aviation bunkers, except at the world level where international bunkers are included in the transport sector. Data sources: Energy balances from the IEA, supplemented by the UNSD for countries not covered by IEA.[13]

Value added (USD 2011 PPP). Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for the depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data source: World Bank's World Development Indicators.[14]

Sectoral indicators

Industry energy intensity (in MJ/USD 2011 PPP): the ratio between industry TFEC and industry value added measured in MJ per USD 2011 PPP.

Industry energy intensity = Industrial TFEC/ industrial value added

Industry corresponds to ISIC divisions 10–45 and includes manufacturing (ISIC divisions 15–37), non-fuel mining and construction. Data sources: Energy balances from the IEA and the UNSD and value added from the WDI

Services energy intensity (in MJ/USD 2011 PPP): ratio between services TFEC and services value added measured in MJ per USD 2011 PPP

Services energy intensity = Services TFEC/ Services value added

Services correspond to ISIC divisions 50–99. They include wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Data sources: energy balances from IEA and UNSD and value added from WDI

Agriculture energy intensity (in MJ/USD 2011 PPP): ratio between agriculture TFEC and agriculture value added measured in MJ per USD 2011 PPP

Agriculture energy intensity = agriculture TFEC/ agriculture value added

Agriculture corresponds to ISIC divisions 1–5 and includes forestry, hunting and fishing, as well as cultivation of crops and livestock production. Data sources: energy balances from IEA and UNSD and value added from WDI

Passenger transport energy intensity (in MJ/ passenger-kilometre (pkm)): ratio between passenger transport TFEC and passenger transport activity measured in MJ/pkm

Passenger transport energy intensity = passenger transport TFEC/pkm

Data source: IEA mobility model

Freight transport energy intensity (in MJ/tkm): ratio between freight transport TFEC and activity measured in MJ per ton-kilometre.

Freight transport energy intensity = freight transport TFEC/ton-kilometre

Data source: IEA mobility model

Residential energy intensity (in MJ/unit of floor area): ratio between residential TFEC and square metres of residential building floor area measured in MJ/m^2 [15]

Residential energy intensity = residential TFEC/ residential floor area

Data source: IEA buildings model[16]

Energy efficiency in energy transformation (electricity generation), transmission and distribution

Fossil fuel electricity generation efficiency (percent): ratio of the electricity output from fossil fuel power generation (coal, oil and gas) and the fossil fuel input to power generation

Generation efficiency = electricity output/fuel input

Data source: IEA energy balances

Power transmission and distribution (T&D) losses (percent)

Power T&D losses = electricity transmission and distribution losses/(electricity output main + electricity output combined heat and power (CHP) + electricity imports) (percent), where: electricity output main is electricity output from main activity producer electricity plants and electricity output CHP is electricity output from combined heat and power plants. Data source: IEA energy balances.[17]

Energy efficiency data challenges in the Arab region

Aggregate activity and energy data are available for most countries. Data collation by the global data compilers (IEA, World Bank and UN Statistics) checks country data quality and continuity and identifies and addresses data gaps and discontinuities in many countries. These data validation processes are undertaken within globally agreed data definitions and quality management processes to ensure reported data meet these standards to the best ability of countries and data compilers.

At a level below country aggregates, the diversity of statistical resources, capabilities and mandates can increasingly constrain sectoral data quality. Industrial, commercial and agricultural energy intensity metrics are based on economic value-added data and analysis of sector energy consumption and depend on the quality of country economic surveys and energy balance allocations. These are tested for consistency with data standards.

Passenger- and freight-sector energy intensity is based on physical activity and allocations of transport fuels. The activity metrics require surveys of passenger journeys and mass of freight carried. In many countries, these data are not collected and SDG 7 tracking at global level relies on survey data, estimates and modelling. In the Arab region, some countries are improving their basic transport data surveys, but a consistent representative data set is not available and SDG 7 tracking for energy intensity analysis currently has to rely on the IEA mobility model.

Residential activity in the SDG 7 energy intensity indicator is based on the residential floor area. Typically derived from building consent data, the quality of these data varies with local control mandates and data systems.

Methodological issues

SDG 7.3 targets a doubling of the rate of energy efficiency improvement at global and country level. It may, however, not represent a reduction in energy use or an implied improvement in energy efficiency as energy intensity aggregates a multiplicity of continuous changes in an economy or sector:

- Activity changes in population, economic value added and GDP output, including changes in currency valuation for exported products. This factor has been important in the region as oil prices have fluctuated significantly recently.
- Income changes, as wealth grows, consumer aspirations and consumption expand.

- Structural changes in the economic mix in a country; sectoral mix changes (growth in services and decline in energy intensive industry); changes in household structure (dwelling size, household occupancy); modal changes in transport (from cars to public transport or active modes); changes within vehicles (vehicle weight, engine capacity).
- Changes in fuel mix and transformation technologies (power generation and desalination technologies) and their management.
- Efficiency changes in: energy technologies (LED lamps, heat pumps, appliances, process plants…), behaviour and management (energy management, DSM, conservation practices) in every home, institution, transport journey and business in an economy.

These factors make tracking actual energy efficiency difficult. Most SDGs are tracked in absolute changes in key variables or directly measurable participation or access rates. SDG 7.3 (and SDG 9) indicators can become quite abstract, given the complexity of changes that contribute to the metrics they purport to track. These SDGs are however some of the most important for the crucial SDG 13 climate objective and for enabling other SDGs via the multiple benefits of energy efficiency.

Beyond energy intensity to policies and SDG outcomes. For national governments, it is far more important to understand how policies are actually working than to track intensity indices. This requires analysis beyond the energy–activity relationships to social well-being, employment and local environmental outcome impacts of policies.

Chapter 3: Renewable energy

The indicator used in this report to track SDG 7.2 is the share of renewable energy in total final energy consumption. Data from IEA and UNSD energy balances are used to calculate the indicator according to the formula:

$$\%TFEC_{RES} = \frac{TFEC_{RES} + \left(TFEC_{ELE} \times \frac{ELE_{RES}}{ELE_{TOTAL}}\right) + \left(TFEC_{HEAT} \times \frac{HEAT_{RES}}{HEAT_{TOTAL}}\right)}{TFEC_{TOTAL}}$$

where the variables are derived from the energy balance flows (TFEC = total final energy consumption, ELE = gross electricity production, HEAT = gross heat production) and their subscripts correspond to the product categories.[18]

The denominator is the TFEC of all energy products, while the numerator, the renewable energy consumption, is defined as the direct consumption of renewable energy sources plus the final consumption of gross electricity and heat that is estimated to have come from renewable sources. This estimation allocates the amount of electricity and heat consumption to renewable sources based on the share of renewables in gross production in order to perform the calculation at the final energy level.

The amount of renewable energy consumption can be divided into three end uses, referring to the energy service for which the energy is consumed: electricity, heat and transport. These are calculated from the energy balance and are defined as follows:

- **Electricity** refers to the amount of electricity consumed in all sectors except transport. Electricity used for heat raising purposes is included because official data on the final energy service are unavailable.
- **Heat raising** refers to the amount of energy consumed for heating purposes in all sectors except transport. It is not equivalent to the final energy end-use service. It is also important to note that in the context of an "end use", heat raising refers to the purpose and does not refer to the energy product "heat" used in the formula above.
- **Transport** refers to the amounts of energy consumed in the transport sector, including electricity. Electricity used in the transport sector is mostly in the rail and road sectors (and in some cases, pipeline transport). The amount of renewable electricity consumed in the transport sector is estimated based on the share of renewable electricity in gross production.

In terms of data analysis, data available to this report ended in 2016, implying the actual tracking period was 2014–2016, rather than 2014–2017. This lack of data illustrates the difficulty of complete data access for data reaching as far back as two years at the time of writing.

The Arab region's data on renewable energy available at the time of writing this report did not include disaggregation between traditional and modern renewable energy, an important distinction at the level of solid biofuel. Since solid biofuel—presumably much of which is traditional in nature—accounts for a large share of energy use in key deficit countries, in particular the Sudan. The Arab region's overall renewable energy trend is disproportionally reflective of renewable energy-consumption trends in traditional solid biofuel. Better data that distinguish between modern and traditional energy and that allow us to better understand the different uses of various types of renewable energy will help improve this analysis in the future.

Appendix

Total electricity access rate

Country	Total electricity access rate (percent)					Urban electricity access rate (percent)	Rural electricity access rate (percent)
	1990	2000	2010	2015	2017	2017	2017
Algeria			99	100	100	100	100
Bahrain			100	100	100	100	100
Egypt		98	100	100	100	100	100
Iraq			98	100	100	100	100
Jordan	97	99	99	100	100	100	100
Kuwait	100	100	100	100	100	100	100
Lebanon			100	100	100	100	100
Libya		100	81	73	70	70	70
Mauritania			34	40	43	83	0
Morocco		70	91	100	100	100	100
Oman			100	100	100	100	100
Qatar	100	100	100	100	100	100	100
Saudi Arabia		-	100	100	100	100	100
State of Palestine		100	100	100	100	100	100
The Sudan	33	23	36	49	56	83	43
Syrian Arab Republic			93	90	90	100	78
Tunisia		95	100	100	100	100	100
United Arab Emirates	100	100	100	100	100	100	100
Yemen		50	66	74	79	98	69

Total access to clean cooking fuels and technologies

Country	Total CFT access rate (percent)						Urban CFT access rate (percent)			Rural CFT access rate (percent)		
	2000	2010	2015	2017 (L)	2017 (M)	2017 (U)	2017 (L)	2017 (M)	2017 (U)	2017 (L)	2017 (M)	2017 (U)
Algeria	88	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Bahrain	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Egypt	85	>95	>95	>95	>95	>95	>95	>95	>95	86	>95	>95
Iraq	72	>95	>95	94	>95	>95	>95	>95	>95	84	>95	>95
Jordan	>95	>95	>95	>95	>95	>95	94	>95	>95	91	>95	>95
Kuwait	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Lebanon												
Libya												
Mauritania	30	39	44	30	46	58	39	71	85	8	21	29
Morocco	91	>95	>95	93	>95	>95	>95	>95	>95	74	94	>95
Oman	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Qatar	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Saudi Arabia	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
State of Palestine*			93.4	>95				>95			>95	
The Sudan	13	29	41	30	44	57	56	70	83	7	30	58
Syrian Arab Republic	>95	>95	>95	>95	>95	>95	>95	>95	>95	84	>95	>95
Tunisia	93	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
United Arab Emirates	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95	>95
Yemen	55	60	63	52	63	75	90	>95	>95	26	48	71

Notes: * Data submitted directly by the Palestinian Electricity Authority

Renewable energy

Country	Share in total final energy consumption (percent)													Final consumption of renewable energy (PJ) (4)			Total final energy consumption (PJ)
	Renewable energy				Solid biofuels	Liquid biofuels	Biogases	Hydro	Wind	Solar	Geothermal	Tide	Municipal waste (renew)	Electricity consumption (2)	Heat raising (3)	Transport (4)	
	1990	2010	2015	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Algeria	0.2%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9	0.3	0.0	1415.6
Bahrain	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	192.7
Egypt	8.5%	5.7%	5.8%	5.7%	3.5%	0.0%	0.0%	1.9%	0.3%	0.0%	0.0%	0.0%	0.0%	47.0	76.6	0.2	2173.9
Iraq	1.6%	1.7%	0.8%	0.9%	0.2%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	5.9	1.2	0.0	761.8
Jordan	2.8%	3.0%	3.2%	4.6%	0.7%	0.0%	0.0%	0.1%	0.5%	3.3%	0.0%	0.0%	0.0%	2.8	8.7	0.0	251.8
Kuwait	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	682.4
Lebanon	11.3%	5.2%	3.6%	3.4%	2.3%	0.0%	0.0%	0.6%	0.0%	0.5%	0.0%	0.0%	0.0%	1.2	5.8	0.0	206.6
Libya	3.1%	1.6%	2.0%	1.6%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	6.4	0.0	393.4
Mauritania	47.0%	34.0%	32.8%	34.6%	33.5%	0.0%	0.0%	0.0%	0.9%	0.2%	0.0%	0.0%	0.0%	0.4	13.6	0.0	40.7
Morocco	19.5%	13.9%	11.2%	11.0%	8.4%	0.0%	0.0%	0.7%	1.7%	0.2%	0.0%	0.0%	0.0%	16.2	52.2	0.2	622.6
Oman	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	749.6
Qatar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	556.2
Saudi Arabia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.3	0.0	4641.4
State of Palestine*	22.1%	14.1%	10.5%	10.1%	6.0%	0.0%	0.0%	0.0%	0.0%	4.1%	0.0%	0.0%	0.0%	0.0	6.8	0.0	67.6
The Sudan	73.3%	61.6%	64.5%	61.6%	56.7%	0.0%	0.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.1	287.6	0.0	507.3
Syrian Arab Republic	2.4%	1.4%	0.5%	1.1%	0.1%	0.0%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.4	0.2	0.0	243.0
Tunisia	14.5%	12.7%	12.6%	12.5%	11.3%	0.0%	0.0%	0.0%	0.4%	0.7%	0.0%	0.0%	0.0%	1.6	38.5	0.0	322.4
United Arab Emirates	0.0%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	1.1	1.9	0.0	2053.9
Yemen	2.2%	1.0%	3.1%	4.5%	2.5%	0.0%	0.0%	0.0%	0.0%	2.1%	0.0%	0.0%	0.0%	2.1	2.5	0.0	101.6

Energy efficiency

Country	Energy intensity (MJ/USD 2011 PPP)					Compound annual growth rate of Energy intensity (percent)			
	1990	2000	2010	2015	2016	1990–2000	2000–2010	2010–2015	2015–2016
Algeria	3.50	3.55	3.61	4.15	3.98	0.1%	0.2%	2.8%	-4.1%
Bahrain	12.60	11.17	10.56	9.95	9.59	-1.2%	-0.6%	-1.2%	-3.6%
Egypt	4.00	3.25	3.69	3.51	3.65	-2.1%	1.3%	-1.0%	4.0%
Iraq	4.20	3.79	4.01	3.68	3.85	-1.0%	0.6%	-1.7%	4.6%
Jordan	6.10	5.52	4.37	4.64	4.74	-1.0%	-2.3%	1.2%	2.2%
Kuwait	1.90	5.47	5.96	5.23	5.38	11.2%	0.9%	-2.6%	2.9%
Lebanon	3.90	5.07	3.74	4.10	4.09	2.7%	-3.0%	1.9%	-0.2%
Libya	4.70	5.64	4.69	6.58	7.01	1.8%	-1.8%	7.0%	6.5%
Mauritania	4.00	3.85	3.73	3.61	3.41	-0.4%	-0.3%	-0.7%	-5.5%
Morocco	3.20	3.53	3.37	3.17	3.13	1.0%	-0.5%	-1.2%	-1.3%
Oman	2.80	3.18	5.68	6.29	5.72	1.3%	6.0%	2.1%	-9.1%
Qatar	8.10	7.13	5.20	6.18	5.83	-1.3%	-3.1%	3.5%	-5.7%
Saudi Arabia	3.50	4.58	6.23	5.80	5.41	2.7%	3.1%	-1.4%	-6.7%
State of Palestine*	4.70	3.06	3.37	3.48	3.56	-4.2%	1.0%	0.6%	2.3%
The Sudan	9.90	7.18	4.69	4.65	4.46	-3.2%	-4.2%	-0.2%	-4.1%
Syrian Arab Republic	7.90	7.29	6.59	11.29	11.81	-0.8%	-1.0%	11.4%	4.6%
Tunisia	4.50	4.16	3.88	3.75	3.75	-0.8%	-0.7%	-0.7%	0.0%
United Arab Emirates	4.20	4.08	5.40	5.29	4.96	-0.3%	2.8%	-0.4%	-6.2%
Yemen	2.60	2.86	3.09	2.48	3.02	1.0%	0.8%	-4.3%	21.8%

Bibliography

African Development Bank Group (2015). Ain Beni Mathar: a unique thermo solar powerplant in Morocco. Available at https://www.afdb.org/en/projects-and-operations/selected-projects/ain-beni-mathar-a-unique-thermo-solar-powerplant-in-morocco-142

African Development Bank (2016). Country Strategy Paper for the Islamic Republic of Mauritania: 2016–2020. Available at https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Mauritania_-_2016-2020_CSP_en.pdf

Al-Khatteeb, L. and H. Istepanian (2015): Turn a Light on: Electricity Sector Reform in Iraq. Brookings Doha Centre Policy Brief. Available at https://www.brookings.edu/wp-content/uploads/2016/06/Alkhatteeb-Istepanian-English-PDF.pdf

Arab Monetary Fund (2019). Database available at https://www.amf.org.ae/en/arabic_economic_database

Arab Union of Electricity (2014). Statistical Bulletin 2014. Available at http://www.auptde.org/PublicationsCat.aspx?lang=en&CID=258

Arab Union of Electricity (2016a). Electricity Tarif in the Arab Countries. Available in Arabic and English. Available at http://auptde.org/Article_Files/Tariffs%202016%20pdf.pdf

Arab Union of Electricity (2016b). Statistical Bulletin 2016. Available at http://www.auptde.org/Article_Files/inside%202017.pdf

Arnold, T. (2019). Saudi's PIF invests more than $1 billion in electric carmaker Lucid Motors. Reuters, 17 September 2018. Available at https://www.reuters.com/article/us-saudi-investment-auto/saudis-pif-invests-more-than-1-billion-in-lucid-motors-idUSKCN1LX1IG

Barltrop, R.(2019). Oil and Gas in a New Libyan Era: Conflict and Continuity, MEP22, Oxford Institute for Energy Studies, February. Available at https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/02/Oil-and-Gas-in-a-New-Libyan-Era-Conflict-and-Continuity-MEP-22.pdf

Bassil, G.(2010). Policy Paper for the Electricity Sector. Available at http://www.databank.com.lb/docs/Policy%20paper%20for%20the%20electricity%20sector%202010.pdf (accessed August 2018)

Caitlin, E. Werrell and Francesco, Femia (Eds.) (2013). The Arab Spring and Climate Change: A Climate and Security Correlations Series (The Center for American Progress, Stimson and The Center for Climate and Security, Washington, DC), p. 24.

Camos, D., R. Bacon, A. Estache and M.M. Hamid (2018). Shedding Light on Electricity Utilities in the Middle East and North Africa: Insights from a Performance Diagnostic. International Bank for Reconstruction and Development/World Bank. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/28684/9781464811821.pdf?sequence=2&isAllowed=y

Carbon Trust (2011). Aluminium. Available at https://www.carbontrust.com/media/38366/ctc790-international-carbon-flows_-aluminium.pdf

Centre for Environment and Development for the Arab Region and Europe (2015). Fuel Economy and CO_2 Emissions of Light-Duty Vehicles in Morocco. Available at http://web.cedare.org/wp-content/uploads/cedareimages/gfei_morocco_report_feb08_final__english.pdf

Centre for Environment and Development for the Arab Region and Europe (2016). Fuel Economy Policies & Labeling for New Cars:Improving Fuel Efficiency and CO_2 Emissions in Egypt. Available at http://pharos.cedare.org/wp-content/uploads/2017/01/Handout-Fuel-Economy-for-Cars_Policy_Brief_EGYPT-GFEI.pdf

CEDRO-UNDP (2014). Lebanon's First National Survey of the Solar Water Heaters Market. Beirut, Lebanon. Available at http://www.cedro-undp.org/content/uploads/publication/141204025125965~LCECCEDRO2014.Lebanon%27sNationalSurveyStudyoftheSHWandPVMarkets.pdf

Central Bureau of Statistics and UNICEF Sudan (2016). Multiple Indicator Cluster Survey 2014 of Sudan: Final Report. Khartoum, Sudan. Available at http://mics.unicef.org/

Clancy, J.S., M. Skutsch and S. Batchelor (undated). The Gender-Energy-Poverty Nexus. Finding the energy to address gender concerns in development. DFID Project CNTR998521. Available at https://www.cleancookingalliance.org/binary-data/RESOURCE/file/000/000/300-2.pdf

Council for Development and Reconstruction (2016). Progress Report. Chapter 10: Physical infrastructure. Available at http://www.cdr.gov.lb/eng/progress_reports/pr102016/Eelec.pdf

Dubai Electricity and Water Authority (2018). Dubai invests AED 500 million in energy efficiency. Avalable at https://www.dewa.gov.ae/en/about-dewa/news-and-media/press-and-news/latest-news/2018/07/dubai-invests-aed-500-million-in-energy-efficiency.

Ecomena (2017). Green Finance in Middle East. Availale at https://www.ecomena.org/green-finance-middle-east/

Eco-union & IEMed (2017). Green Finance the Mediterranean. Available at http://www.medgreeneconomy.org/content-images/Med-Green-Finance-2017.pdf

El-Ashry, M., N. Saab and B. Zeitoon (Eds) (2010). Arab Water: Sustainable Management of a Scarce Resource. Beirut: Arab Forum for Environment and Development. Available at https://www.undp.org/content/dam/rbas/doc/Energy%20and%20Environment/Arab_Water_Gov_Report/Arab_Water_Gov_Report_Full_Final_Nov_27.pdf

El-Katiri, L. (2014). Energy Poverty in the Middle East and North Africa. In: A. Halff, B.K. Sovacool and J. Rozhon, 2014: Energy Poverty. Global Challenges and Local Solutions. Oxford University Press, 273–297. [Link]

Energy Access Platform (2019). The Need for Clean Cooking Solutions. http://energyaccessplatform.org/index.php/focus-areas/clean-cooking

Energy Saving Association (2014). 40,000 inefficient air-con units confiscated. ESA News

http://www.the-esa.org/news/articles/-/40-000-inefficient-air-con-units-confiscated

Fattouh B. and L. El-Katiri (2011). Energy Poverty in the Arab World: The Case of Yemen, MEP1, Oxford Institute for Energy Studies, August 2011. Available at https://core.ac.uk/download/pdf/9427296.pdf

Fattouh, B. and L. El-Katiri, (2012). Energy Subsidies in the Arab World, UNDP. https://www.undp.org/content/dam/rbas/report/Energy%20Subsidies-Bassam%20Fattouh-Final.pdf

Fattouh, B. and L. El-Katiri (2012b). Arab Human Development Report Research Paper, UNDP

Fattouh B. and L. El-Katiri, 2017: A Brief Political Economy of Energy Subsidies in the Middle East and North Africa, International Development Policy. Revue internationale de politique de développement. Avalable at http://journals.openedition.org/poldev/2267

Gebrayel, T. (2017). The Evolvement of the Solar Water Heaters Market in Lebanon. Presentation at Beirut Energy Forum, 20 September 2017. Available at http://beirutenergyforum.com/files/309/session%2014/The%20Evolvement%20of%20the%20Solar%20Water%20Heaters%20Market%20in%20Lebanon.pdf

Global Fuel Economy Initiative (2016). Fuel Economy State of the World 2016. Available at https://www.globalfueleconomy.org/media/203446/gfei-state-of-the-world-report-2016.pdf

Gobat, J. and K. Kostial, 2016: Syria's Conflict Economy. IMF Working Paper. https://www.imf.org/external/pubs/ft/wp/2016/wp16123.pdf

Gonzalez Pijuan, I., 2018: Gender inequality and energy poverty: A forgotten risk factor. Engineering Without Borders, ESFeris Studies. Avaialble at https://esf-cat.org/wp-content/uploads/2018/02/ESFeres17-PobresaEnergeticaiDesigualtatdeGenere-ENG.pdf

Government of Abu Dhabi (undated). The Water Resources Management Strategy for the Emirate of Abu Dhabi, 2014–2018. Available at

https://www.ead.ae/Documents/PDF-Files/Executive-Summary-of-The-Water-Resources-Management-Strategy-for-the-Emirate-of-Abu-Dhabi-2014-2018-Eng.pdf

Government of the United Arab Emirates, 2018: UAE Energy Strategy 2050. https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/uae-energy-strategy-2050

Gulf Business, 2019: Saudi to produce 60 GW of renewable energy by 2030, says official. 14 January 2019.https://gulfbusiness.com/saudi-produce-60-gw-renewable-energy-2030-says-official/

Gunning, R. (2014). The Current State of Sustainable Energy Provision for Displaced Populations: An Analysis. Research Paper, Chatham House. Available at https://www.chathamhouse.org/sites/default/files/field/field_document/20141201EnergyDisplacedPopulationsGunning.pdf (accessed on August 2018)

Habre, O. (2018). New tax exemptions for eco-friendly cars. Executive Magazine, 29 May 2018. Available at https://life.executive-magazine.com/auto/new-tax-exemptions-eco-friendly-cars

Huenteler, J.T., A. Khanna, S. Badiei, T.M. Matsuo, E. Maier and E.M. Fernstrom (2017). Republic of Yemen - Restoring and expanding energy access: power sector reengagement note. World Bank Group, Washington DC. International Energy Agency (2012). World Energy Outlook Special Report: Iraq Energy Outlook, (October 2012)

International Energy Agency (2014). Energy Efficiency Market Report 2014 Available at https://webstore.iea.org/energy-efficiency-market-report-2014

International Energy Agency (2015). Capturing the Multiple Benefits of Energy Efficiency. Available at https://www.iea.org/publications/freepublications/publication/Multiple_Benefits_of_Energy_Efficiency.pdf

International Energy Agency, 2016: Algeria - Renewable Energy and Energy Efficiency Development Plan 2015–2030. IEA/IRENA Joint Policies and Measures Database. https://www.iea.org/policiesandmeasures/pams/algeria/name-157163-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-

International Energy Agency (2017). Tracking Clean Energy Progress 2017. Available at https://www.iea.org/publications/freepublications/publication/TrackingCleanEnergyProgress2017.pdf

International Energy Agency (2018). World Energy Statistics and Balances Database, World Energy Balances. Available at https://www.oecd-ilibrary.org/energy/data/iea-world-energy-statistics-and-balances/world-energy-balances_data-00512-en?parentId=http%3A%2F%2Finstance.metastore.ingenta.com%2Fcontent%2Fcollection%2Fenestats-data-en

International Energy Agency (2019). Iraq's Energy Sector: A Roadmap to a Brighter Future. Available at https://webstore.iea.org/download/direct/2700?fileName=Iraq_Energy_Outlook.pdf

International Energy Agency and World Bank (2017). Sustainable Energy for All 2017—Progress toward Sustainable Energy. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO. Available at http://trackingsdg7.esmap.org/downloads

International Monetary Fund (2013). Energy Subsidy Reform: Lessons and Implications. Washington DC, January 2013.

International Monetary Fund (2014). Subsidy Reform in the Middle East and North Africa. Recent Challenges and

Progress Ahead. Available at http://www.imf.org/external/pubs/ft/dp/2014/1403mcd.pdf.

International Monetary Fund (2017a). Gulf Cooperation Council: The Economic Outlook and Policy Challenges in the GCC Countries. https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/12/14/pp121417gcc-economic-outlook-and-policy-challenges

International Monetary Fund (2017b).: Sudan: Article IV Consultation. https://www.imf.org/en/Publications/CR/Issues/2017/12/11/Sudan-2017-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-Executive-45456

Intergovernmental Panel on Climate Change (2014). Summary for Policymakers in: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Available at https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

International Renewable Energy Agency (2015). Renewables Readiness Assessment: Mauritania. Abu Dhabi. Available at https://www.irena.org/publications/2015/Sep/Renewables-Readiness-Assessment-Mauritania.

International Renewable Energy Agency (2016). Renewable Energy in the Arab Region: Overview of developments. Abu Dhabi. https://www.irena.org/publications/2016/Dec/Renewable-Energy-in-the-Arab-Region-Overview-of-developments

International Renewable Energy Agency (2018a). Renewable Energy Outlook: Egypt. Abu Dhabi. https://www.irena.org/publications/2018/Oct/Renewable-Energy-Outlook-Egypt

International Renewable Energy Agency (2018b). Renewable Energy Statistics 2018. Abu Dhabi. Available at https://www.irena.org/publications/2018/Jul/Renewable-Energy-Statistics-2018

International Renewable Energy Agency (2019a). Renewable Energy Market Analysis: GCC 2019. Abu Dhabi. https://www.irena.org/publications/2019/Jan/Renewable-Energy-Market-Analysis-GCC-2019

International Renewable Energy Agency (2019b). Renewable Capacity Statistics 2019. Abu Dhabi. Available at https://www.irena.org/publications/2019/Mar/Renewable-Capacity-Statistics-2019

International Renewable Energy Agency (2019c). Global Atlas for Renewable Energy. Abu Dhabi. Available at https://www.irena.org/globalatlas

International Renewable Energy Agency (2019d). Off-grid renewable energy solutions to expand electricity access: An opportunity not to be missed. Abu Dhabi. Available at https://www.irena.org/publications/2019/Jan/Off-grid-renewable-energy-solutions-to-expand-electricity-to-access-An-opportunity-not-to-be-missed

Jabbour, M. (2017). The NEEREA Momentum: The Yearly Update. Presentation at the International Beirut Energy Forum, 18 September 2017, Lebanon. Available at http://lcec.org.lb/Content/uploads/Presentation/180226115948055~NEEREA%20Update%20-%20iBEF%202017.pdf

Jordan Response Platform for the Syria Crisis (2019). Jordan Response Plan for the Syrian Crisis 2019. Available at https://static1.squarespace.com/static/522c2552e4b0d3c39ccd1e00/t/5c9211e6e79c7001701ba9b3/1553076715901/Final+2019+JRP.pdf.

King Abdullah Petroleum Studies and Research Center (2019). Estimating the Multiple Benefits of Building Energy Efficiency in GCC Countries Using an Energy Productivity Framework, p. 14. Available at https://www.kapsarc.org/research/publications/estimating-the-multiple-benefits-of-building-energy-efficiency-in-gcc-countries-using-an-energy-productivity-framework/

Kuwait News Agency (2018). KISR: Shagaya project first step toward energy diversification. 15 March 2018. https://www.kuna.net.kw/ArticleDetails.aspx?id=2703316&language=en#

Lahn, G., O. Grafham and A. Elsayed Sparr (2016). Moving Energy Initiative, Amman, 19–20 April 2016. Available at https://www.chathamhouse.org/sites/default/files/publications/research/2016-08-03-refugees-energy-jordan-lahn-grafham-sparr.pdf (accessed August 2018)

Lahn, G., P. Stevens F. and Preston (2013): Saving Oil and Gas in the Gulf. Available at http://www.chathamhouse.org/sites/default/files/public/Research/Energy%2C%20Environment%20and%20Development/0813r_gulfoilandgas.pdf.

Lambert, T. and Afar Consulting (2018). Yemen Multi-Sector Early Recovery Assessment, UNDP. Available at https://reliefweb.int/sites/reliefweb.int/files/resources/yemen-multisector-earlyrecoveryassessment.pdf

Mahmoud, M., R. Al-Shaibani, A. Almohamadi, K. Hashim, A. Cabanero and K. Saeed (2017). Assessment of the Status of Solar PV in Yemen. Regional Centre for Renewable Energy and Energy Efficiency (RCREEE). Available at http://www.rcreee.org/sites/default/files/121707-wp-public-p158449-wb-rcreee-solar-pv-in-yemen-report-002.pdf

Masdar (undated): The Sheikh Zayed Solar Power Plant.

https://masdar.ae/en/masdar-clean-energy/projects/the-sheikh-zayed-solar-power-plant

Mater, W. (2019). Response to Changes in Electricity Prices: A Microeconomic-Physical Approach. KAPSARC. https://www.kapsarc.org/research/publications/households-demand-response-to-changes-in-electricity-prices-a-microeconomic-physical-approach

McDowall, A. (2019). World Bank urges new Lebanese government to reform power sector. Reuters, 1 February 2019. Available at https://www.reuters.com/article/us-lebanon-government-reforms/world-bank-urges-new-lebanese-government-to-reform-power-sector-idUSKCN1PQ4Y1

Middle East Economic Survey (2017). Iraq Adds Upgrades to Gas-Fired Plans, Keeping Pressure on Rising Supplies (8 December 2017) Available at https://www.mees.com/index.php/2017/12/8/power-water/iraq-adds-upgrades-to-gas-fired-plans-keeping-pressure-on-rising-supplies/76d221e0-dc34-11e7-8844-dd5937b94b13

Middle East Solar Industry Association (2018). Solar Outlook Report 2018. Available at www.mesia.com/wp-content/uploads/2018/03/MESIA-OUTLOOK-2018-Report-7March2018.pdf

Naim, M. (2017.) The Impact of the Syrian Crisis on the Lebanese Power Sector and Priority Recommendations: Part 1. Survey & Methodology. Ministry of Energy and Water Energy Sector Workshop, 21 February 2017. Available at http://www.cedro-undp.org/content/uploads/event/17030 1012308801~EnergySectorWorkshop-21-02-2017-Final.pdf (accessed August 2018)

Nature Energy (2018). Well-to-refinery emissions and net-energy analysis of China's crude-oil supply. Available at https://www.nature.com/articles/s41560-018-0090-7

Napoli, C. and Garcia-Tellez, B. (2016). A framework for understanding energy for water. International Journal of Water Resources Development, 32 (3), 339–361. 10.1080/07900627.2015.1122579. Available at https://www.tandfonline.com/doi/full/10.1080/07900627.2015.1122579

National Energy Research Centre and Royal Scientific Society (2014). Assessment of Renewable Energy Projects through Public-Private Partnerships: Case Studies in Rural Areas of Jordan. ESCWA. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_14_tp-1.pdf

Oxfam International (2016). From the Ground Up: Gender and Conflict Analysis in Yemen. Oxford. Available at https://oxfamilibrary.openrepository.com/bitstream/handle/10546/620112/rr-yemen-gender-conflict-analysis-201016-enpdf;jsessionid=E53D36BEB61F42EA325182094E66EFF4?sequence=1

Planning and Statistics Authority (2018). Second Voluntary National Review. Available at https://www.psa.gov.qa/en/knowledge/Doc/QNV/Report%20of%20the%20National%20Voluntary%20review%202018%20(Landscape).pdf#search=second%20voluntary%20national%20review

Power Technology (undated): Miraah Solar Thermal Project. Available at https://www.power-technology.com/projects/miraah-solar-thermal-project/

Raydan, N. and E. Salomon (2016). Syrians use pedal power to get electricity flowing. Financial Times, 22 May 2016. Available at https://www.ft.com/content/6809b4ec-1e82-11e6-b286-cddde55ca122.

Regional Center for Renewable Energy and Energy Efficiency (2017). Arab Future Energy Index AFEX 2017 Energy Efficiency. Available at http://www.rcreee.org/content/arab-future-energy-index-afex-2017-energy-efficiency

Rehab Abd Almohsen (2015). Thousands die in Yemen in fights over water, 25 June 2015. Available at http://www.scidev.net/global/water/news/water-death-yemen-conflict.html

Saudi Aramco (2019). Saudi Aramco Climate Initiatives 2019. Available at https://www.saudiaramco.com/en/making-a-difference/planet/climateinitiative#Carbon%20intensity

SABIC (2017). Building a Better Future Sustainability Report 2017. Available at https://www.sabic.com/assets/en/Images/Sustainability-Report-2017-English_tcm1010-12631.pdf

Saudi Energy Efficiency Center (2018a). Enhancing Vehicles Energy Efficiency in Saudi Arabia, G20 Transport Task Group workshop Buenos Aires, Argentina, September, 2018. Available at https://theicct.org/sites/default/files/KSA_AlRoge_Enhancing%20Vehicles%20Energy%20Efficiency%20in%20Saudi%20Arabia.pdf

Saudi Energy Efficiency Center (2018b). COP24 Dec 2018. Available at https://ksa-climate.com/wp-content/uploads/2018/12/Raed-Al-Schneiber_SEEC.pdf

Sustainable Energy Unit (2018). About the Sustainable Energy Unit. Bahrain. http://www.seu.gov.bh/about-2/

Sdralevich, C., R. Sab, Y. Zouhar, and G. Albertin (2014): Subsidy Reform in the Middle East and North Africa: Recent Progress and Challenges Ahead.

Strategy& (2012). Unlocking the potential of district cooling. The need for GCC governments to take action. Available at https://www.strategyand.pwc.com/m1/en/reports/unlocking-the-potential-of-district-cooling.pdf

Taha, K. (2018). Renewable energy on rise in resource-poor Jordan. Phys.Org, 28 September 2018. Available at https://phys.org/news/2018-09-renewable-energy-resource-poor-jordan.html

Tamara and Rubal Dua (2019). Drivers of New Light-Duty Vehicle Fleet Fuel Economy in Saudi Arabia. KS--2019-DP54. Riyadh: KAPSARC. Available at: https://doi.org/10.30573/KS--2019-DP54.

Temasol (undated): Au Maroc, grâce à l'énergie solaire, les foyers les plus isolés accèdent au confort de l'électricité. In French.http://ecolo.org/documents/documents_in_french/Solar-Temasol-Maroc-03-05.pdf

Tizgui, I. et al. (2018). Estimation and Analysis of Wind Electricity Production Cost in Morocco. International Journal of Energy Economics and Policy, 8(3), 58–66.

Tsagas, I. (2018). Lebanon aims to source 30% of heat and power from renewables by 2030. pv Magazine, 6 November 2018.https://www.pv-magazine.com/2018/11/06/lebanon-aims-to-source-30-of-heat-and-power-from-renewables-by-2030/

The Economist (2016). The roasting of the Middle East: infertile crescent", 6 August 2016. Available at https://www.economist.com/middle-east-and-africa/2016/08/06/infertile-crescent

The Guardian (2015). Water scarcity in Yemen: the country's forgotten conflict" Available at https://www.theguardian.com/global-development-professionals-network/2015/apr/02/water-scarcity-yemen-conflict

UAE Ministry of Energy and Industry (2017). Vice President unveils UAE energy strategy for next three decades.https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/uae-energy-strategy-2050

International Association of Public Transport (2019). MENA Transport Report 2019. Available at https://mena.uitp.org/mena-transport-report-2019.

United Nations (2007). Peace and Security Section of the United Nations Department of Public information. The United Nations and Darfur. Available at https://reliefweb.int/sites/reliefweb.int/files/resources/C0AC65F076BF903649257316000BD5DC-Full_Report.pdf

United Nations (2017). Operations of the United Nations Relief and Works Agency for Palestine Refugees in the Near East. Report of the Secretary-General, General Assembly, Seventy-first session, Agenda item 49, United Nations Relief and Works Agency for Palestine Refugees in the Near East, 30 March 2017. A/71/849. Available at: https://www.unrwa.org/sites/default/files/content/resources/sg_report_english.pdf

United Nations (2019a). Sustainable Development Goal 13. Sustainable Development Goals Knowledge Platform. Available at https://sustainabledevelopment.un.org/sdg13

United Nations (2019b). The Sustainable Development Goals report. https://www.un.org/sustainabledevelopment/progress-report/

United Nations Economic and Social Commission of Western Asia (2014). Assessment of Renewable Energy Projects through Public–Private Partnerships: Case Studies in Rural Areas of Jordan www.unescwa.org/publications/assessment-renewable-energy-projects-through-public-private-partnerships-case-studies

United Nations Economic and Social Commission of Western Asia (2015a). Climate Projections and Extreme Climate Indices for the Arab Region. Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR). Available at E/ESCWA/SDPD/2015/Booklet.2. Beirut

United Nations Economic and Social Commission of Western Asia (2015b). Population and Development Report Issue No. 7. Overcoming Population Vulnerability to Water Scarcity in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/arab-population-vulnerability-water-scarcity-2015-english.pdf

United Nations Economic and Social Commission of Western Asia (2015c). Water Development Report 6. The water, energy and food security nexus in the Arab region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_15_2_e_0.pdf.

United Nations Economic and Social Commission of Western Asia (2016a). Conflict, Climate Change and Their Mutually Reinforcing Impact on Gender Imbalances in the Arab Region. Available at https://www.unescwa.org/publications/gender-climate-change-conflict

United Nations Economic and Social Commission of Western Asia (2016b). Developing the Capacity of ESCWA Member Countries to Address the Water and Energy Nexus for Achieving Sustainable Development Goals, Regional Policy Toolkit. Available at https://www.unescwa.org/publications/water-energy-nexus-regional-policy-toolkit

United Nations Economic and Social Commission of Western Asia (2017a). Arab Region Progress in Sustainable Energy: Global Tracking Framework regional report. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/gtf-regional-report-arab-region-progress-sustainable-energy-english_1.pdf

United Nations Economic and Social Commission of Western Asia (2017b). Climate Change and Disaster Risk Reduction in the Arab Region. ESCWA Water Development Report 7. E/ESCWA/SDPD/2017/3.

United Nations Economic and Social Commission of Western Asia (2017c). Energy Efficiency Indicators in Intensive Energy Consuming Industries in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/energy-efficiency-indicators-industries-heavy-industries-arab-region-english.pdf

United Nations Economic and Social Commission of Western Asia (2017d). Climate Change Adaptation in the Health Sector Using Integrated Water Resources Management Tools. Available at https://www.unescwa.org/publications/adaptation-climate-change-protect-human-health

United Nations Economic and Social Commission of Western Asia (2017e). Sustainable energy in the Arab region. Energy-related sustainable development goals. Committee on Energy, Eleventh session. Available at https://www.unescwa.org/sites/www.unescwa.org/files/events/files/sustainable_energy_in_the_arab_region_energy-related_sustainable_development_goals.pdf

United Nations Economic and Social Commission of Western Asia (2017f). Innovation Policy for Inclusive Sustainable Development in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/innovation-policy-inclusive-sustainable-development-arab-region-english_0.pdf

United Nations Economic and Social Commission of Western Asia (2017g). Climate Change Adaptation and Ecosystem-Based Management Using Integrated Water Resources Management Tools. Available at https://www.unescwa.org/publications/ecosystem-management-integrated-water-resources-management

United Nations Economic and Social Commission of Western Asia (2017h). The Social Impacts of Energy Subsidy Reform in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/social-impacts-energy-subsidy-reform-en.pdf

United Nations Economic and Social Commission of Western Asia (2018a). Addressing energy sustainability in the buildings sector in the Arab region. Available at https://www.unescwa.org/publications/addressing-energy-sustainability-issues-buildings-sectori-arab-region

United Nations Economic and Social Commission of Western Asia (2018b). Case Study on Policy Reforms to Promote Renewable Energy in Morocco.

https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/policy-reforms-promote-renewable-energy-morocco-english.pdf (accessed August 2018)

United Nations Economic and Social Commission of Western Asia (2018c). Case Study on Policy Reforms to Promote Renewable Energy in the United Arab Emirates. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/policy-reforms-promote-renewable-energy-uae-english.pdf

United Nations Economic and Social Commission of Western Asia 2018(d). Case Study on Policy Reforms to Promote Renewable Energy in Jordan.https://www.unescwa.org/sites/

www.unescwa.org/files/publications/files/policy-reforms-promote-renewable-energy-jordan-english.pdf (accessed August 2018)

United Nations Economic and Social Commission of Western Asia (2018e). Case Study on Policy Reforms to Promote Renewable Energy in Lebanon. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/policy-reforms-promote-renewable-energy-lebanon-english.pdf (accessed August 2018).

United Nations Economic and Social Commission of Western Asia (2018f). Progress on Shared Water Resources Management in the Arab Region: Regional baseline for SDG Indicator 6.5.2. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/progress_on_shared_water_resources_management_in_the_arab_region.pdf

United Nations Economic and Social Commission of Western Asia (2018g). Member States establish Arab Centre for Climate Change Policies at ESCWA 30th Ministerial Session. Available at https://www.unescwa.org/news/member-states-establish-arab-centre-climate-change-policies-escwa-30th-ministerial-session. For the foundation document, see https://www.unescwa.org/sites/www.unescwa.org/files/events/files/proposal_for_the_establishment_of_an_arab_centre.pdf.

United Nations Economic and Social Commission of Western Asia (2019a). Energy Vulnerability in the Arab Region. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/energy-vulnerability-arab-region-english_0.pdf

United Nations Economic and Social Commission of Western Asia (2019b). Report on the Seminar on Monitoring the Implementation of Energy Related SDG Indicators in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/events/files/monitoring_energy_related_sdgs_seminar-report.pdf

United Nations Economic and Social Commission of Western Asia (2019c). The Role of Super ESCOs in Upscaling Energy Efficiency in the Arab Region. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/superescos_wp._05april2019.pdf

United Nations Economic and Social Commission of Western Asia et al. (2017). Arab Climate Change Assessment Report: Main Report. Beirut. E/ESCWA/SDPD/2017/RICCAR/Report. Available at https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/riccar-main-report-2017-english_0.pdf

United Nations Development Programme (2013a). Derisking Renewable Energy Investment. A Framework to Support Policymakers in Selecting Public Instruments to Promote Renewable Energy Investment in Developing Countries. http://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment/derisking-renewable-energy-investment.html

United Nations Development Programme (2013b). Gender and energy. Available at https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB4-AP-Gender-and-Energy.pdf

United Nations Development Programme (2013c). Water Governance in the Arab Region: Managing Scarcity and Securing the Future. Available at http://www.arabstates.undp.org/content/rbas/en/home/library/huma_development/water-governance-in-the-arab-region.html

United Nations Development Programme et al. (2013). Women and Natural Resources: Unlocking the Peacebuilding Potential. Available at https://www.europe.undp.org/content/geneva/en/home/partnerships/women-and-natural-resources--unlocking-the-peacebuilding-potenti.html

United Nations Development Programme (2016). Strategic Framework for Cooperation between the Government of the Syrian Arab Republic and the United Nations 2016-2017. https://www.undp.org/content/dam/syria/docs/Framework/UN%20Strategic%20Framework%20for%20Syria%202016-17.pdf

United Nations Development Programme (2017). Lebanon Crisis Response Plan 2017–2020, Part II: Operational Response Plans – Energy. Available at http://www.un.org.lb/library/assets/Energy.pdf

United Nations Development Programme (2018a). Tunisia: Derisking Renewable Energy Investment 2018. Available at https://newclimate.org/wp-content/uploads/2018/06/DREI_Tunisia_Report_2018_Full_Results_English.pdf

United Nations Development Programme (2018b). Derisking Renewable Energy Investment. Project web page. Available at https://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment.html

United Nations Development Programme (2018c). Derisking Renewable Energy Investment: Off-Grid Electrification. Available at https://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment/drei--off-grid-electrification--2018-.html

United Nations Development Programme (undated a). UNDP helps Lebanon kick off solar powered schools. Available at http://www.arabstates.undp.org/content/rbas/en/home/ourwork/sustainable-development/successstories/solar-schools-lebanon.html

United Nations Development Programme (undated b). Gaza schools go solar. Available at http://www.arabstates.undp.org/content/rbas/en/home/ourwork/sustainable-development/successstories/gaza-schools-go-solar.html

United Nations Development Programme (undated c). Project

Document: Promoting Sustainable Mini-grids in Mauritanian provinces through hybrid technologies. Available at https://www.thegef.org/sites/default/files/project_documents/11-11-15_Project_Document_PADpdf_0.pdf

United Nations Development Programme / Decentralized Renewable Energy Power Generation (2018). 2017 Solar PV Status Report for Lebanon. Available at http://www.lb.undp.org/content/lebanon/en/home/library/environment_energy/The-2017-Solar-PV-Status-Report-for-Lebanon.html

United Nations Framework Convention on Climate Change (2010). Improvement of Urban Transportation The Case of Egypt. Available at http://unfccc.int/resource/webcast/collections/dna10/downloads/DNA_Forum_Day2_0915_Improvement_of_Urban_Transportation_in_Egypt_DNA_Egypt.pdf

United Nations Framework Convention on Climate Change (2015). Yemen Intended Nationally Determined Contribution. Available at https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Yemen/1/Yemen%20INDC%2021%20Nov.%202015.pdf.

United Nations Framework Convention on Climate Change (2017). Egyptian Intended Nationally Determined Contribution. Available at https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Egypt%20First/Egyptian%20INDC.pdf

United Nations High Commission for Refugees, 2017(a): The Impact of the Syrian Crisis on the Lebanese Power Sector and Priority Recommendations—Final report. February. https://data2.unhcr.org/fr/documents/download/64718.

United Nations High Commission for Refugees (2017b). Global Report 2017. Available at http://reporting.unhcr.org/sites/default/files/gr2017/pdf/GR2017_English_Full_lowres.pdf

United Nations High Commission for Refugees (2018). Humanitarian Needs Review 2019. Available at https://data2.unhcr.org/en/documents/download/67416

United Nations High Commission for Refugees (2019a). Iraq Emergency. Available at: https://www.unhcr.org/iraq-emergency.html

United Nations High Commission for Refugees (2019b). Syria Emergency.https://www.unhcr.org/syria-emergency.html

United Nations High Commission for Refugees (2019c). Yemen Emergency. Available at https://www.unhcr.org/yemen-emergency.html

United Nations Relief and Works Agency (2018). Occupied Palestinian Territory. Emergency Appeal 2018. Available at https://www.unrwa.org/sites/default/files/content/resources/2018_opt_ea_final_web.pdf

United Nations Statistics (2019). UN data. Available at http://data.un.org/_Docs/SYB/CSV/SYB62_T23_201904_Production,%20Trade%20and%20Supply%20of%20Energy.csv

United Nations Statistics Division (2018). Energy Statistics, Energy Balances. Available at https://unstats.un.org/unsd/energystats/pubs/balance/

University of Khartoum (2003). Faculty of Engineering & Architecture Department of Mechanical Engineering, Determination of outdoor conditions for air-conditioning system design in the Sudan. (Khartoum case study). Available at http://khartoumspace.uofk.edu/bitstream/handle/123456789/9667/DETERMINATION%20OF%20OUTDOOR%20CONDITIONS%20FOR.pdf?sequence=1&isAllowed=y

University of Khartoum (2010). Faculty of Engineering & Architecture Department of Mechanical Engineering, A solar Assisted Winter Air-Conditioning System for Hot and Dry Climates Using Summer Air-Coolers. Available at https://repository.up.ac.za/bitstream/handle/2263/49897/El-Awad_Solar-Assisted_2015.pdf?sequence=1

Verme, P. (2016). Subsidy Reforms in the Middle East and North Africa Region: A Review. World Bank Group. Policy Research Working Paper 7754. https://openknowledge.worldbank.org/bitstream/handle/10986/24835/Subsidy0reform0ca0Region000a0review.pdf?sequence=1&isAllowed=y

World Bank (2005b). Household Energy Supply and Use in Yemen, Volume II, Annexes, Report No. 315/05, December.

World Bank (2008). Republic of Lebanon Electricity Sector Public Expenditure Review. Report No. 41421-LB, 31 January 2008. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/7990/414210REPLACEM1closed0April01502008.pdf?sequence=1&isAllowed=y (accessed August 2018)

World Bank (2009). Energy Efficiency Study in Lebanon. Report No. 70302. http://climatechange.moe.gov.lb/viewfile.aspx?id=205

World Bank (2012). Adaptation to a changing climate in the Arab world: fact sheet. Available at http://siteresources.worldbank.org/MENAEXT/Resources/MENA_climate_facts_COP18_English.pdf.

World Bank (2017a). Securing Energy for Development in West Bank and Gaza. Available at http://documents.worldbank.org/curated/en/351061505722970487/pdf/119769-WP-P157348-v1-Securing-Energy-PUBLIC-ACS.pdf (accessed August 2018)

World Bank (2017b). International Development Association Project Appraisal Document on a Proposed Grant in the Amount of SDR106.2 million ($150 million equivalent) to the United Nations Office for Project Services for the Benefit of the Republic of Yemen. Report No: PAD2487, 20 October 2017. Available at http://documents.worldbank.org/curated/en/108561509847237071/pdf/Yemen-Integrated-Urban-PAD2487-PAD-P164190-3-10242017.pdf

World Bank (2017c). Regulatory Indicators for Sustainable Energy. https://rise.esmap.org/scores

World Bank (2017d). The Toll of War: Economic and Social Impact Analysis (ESIA) of the Conflict in Syria - Key Facts. Available at https://www.worldbank.org/en/country/syria/brief/the-toll-of-war-economic-and-social-impact-analysis-esia-of-the-conflict-in-syria-key-facts

World Bank (2018a). Combined Project Information Documents/Integrated Safeguards Datasheet (PID/ISDS). Yemen Emergency Electricity Access Project. Report No. PIDISDSA24561, 26 March 2018. Available at http://

documents.worldbank.org/curated/en/895191523306712217/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Yemen-Emergency-Electricity-Access-Project-P163777.pdf

World Bank (2018b). Country Partnership Framework for the Islamic Republic of Mauritania for the period fy18–fy23. International Development Association, International Finance Corporation and Multilateral Investment Guarantee Agency, 13 June 2018. Report No. 125012-MR. Available at http://documents.worldbank.org/curated/en/288231531625439579/pdf/MAURITANIA-CPF-NEW-06192018.pdf

World Bank (2018c). Enterprise Surveys. Database. Available at http://www.enterprisesurveys.org/Custom-Query#Economies (accessed August 2018)

World Bank (2018d). Tracking SDG7: The Energy Progress Report 2018. https://trackingsdg7.esmap.org/data/files/download-documents/tracking_sdg7-the_energy_progress_report_full_report.pdf

World Bank (2018e). Egypt: Pioneering Participatory Integrated Water Resources Management in the Nile Delta" Result Briefs. Available at https://www.worldbank.org/en/results/2018/08/02/egypt-pioneering-participatory-integrated-water-resources-management-in-the-nile-delta

World Bank (2018f). Egypt: Scrapping and Recycling Old Vehicles to Lower Pollution and Improve Livelihoods. Available at http://www.worldbank.org/en/news/feature/2018/10/25/egypt-scrapping-and-recycling-old-vehicles-to-lower-pollution-and-improve-livelihoods

World Bank (2019a). Lighting Africa – Mauritania. Project website. Available at https://www.lightingafrica.org/country/mauritania/

World Bank (2019b). World development indicators. Washington, DC. Available at https://datacatalog.worldbank.org/dataset/world-development-indicators

World Bank (2019c). Poverty and Equity Database. Available at https://datacatalog.worldbank.org/dataset/poverty-and-equity-database

World Bank (2019d). 2019 Tracking SDG 7 - The Energy Progress Report. Available at https://trackingsdg7.esmap.org/data/files/download-documents/2019-Tracking%20SDG7-Full%20Report.pdf

World Bank (2019e). RISE – Regulatory Indicators for Sustainable Energy. Available at http://www.worldbank.org/en/topic/energy/publication/rise---regulatory-indicators-for-sustainable-energy

World Bank and Bank-Netherlands Water Partnership (BNWP) (2004). Seawater and Brackish Water Desalination in the Middle East, North Africa and Central Asia: A Review of Key Issues and Experience in Six Countries. World Bank Working Paper 33515. Washington, DC

World Bank and Energy Sector Management Assistance Programme (2017). Securing Energy for Development in West Bank and Gaza. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/28468/119769-WP-P157348-v1-Securing-Energy-PUBLIC-ACS.pdf?sequence=1&isAllowed=y

World Bank and Energy Sector Management Assistance Programme (ESMAP), undated. The Gender - Energy- Poverty nexs. Available at https://www.esmap.org/sites/default/files/esmap-files/The%20Gender%20Energy%20Poverty%20Nexus.pdf

World Economic Forum (2018). The Arab World Competitiveness Report http://www3.weforum.org/docs/Arab-World-Competitiveness-Report-2018/AWCR%202018.0724_1342.pdf

World Health Organization (2016). WHO Global Urban Ambient Air Pollution Database (update 2016). Available at https://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

World Health Organization (2018). Exposure to ambient air pollution from particulate matter for 2016. Available at https://www.who.int/airpollution/data/AAP_exposure_Apr2018_final.pdf?ua=1

World Health Organization (2019). 2019 Tracking SDG 7 - The Energy Progress Report. Available at https://trackingsdg7.esmap.org/data/files/download-documents/2019-Tracking%20SDG7-Full%20Report.pdf

World Resources Institute (2016). Examining the alignment between the intended nationally determined contributions and Sustainable Development Goals. Available at https://www.wri.org/publication/examining-alignment-between-intended-nationally-determined-contributions-and-sustainable

Wright, R. (2017). The Lights are Going out in the Middle East, The New Yorker, 21 May 2017. Available at https://www.newyorker.com/news/news-desk/the-lights-are-going-out-in-the-middle-east.

Endnotes

Introduction

1. See also United Nations Economic and Social Commission of Western Asia, 2019a. also add it in text.

Chapter 1

1. United Nations High Commission for Refugees, 2017b.
2. United Nations, 2017.
3. Since electricity access measures any form of access, it is likely that the data includes gains in access due to standalone solar systems, particularly in Yemen.
4. Central Bureau of Statistics and UNICEF Sudan (2016)
5. World Bank, 2019a
6. UNHCR, 2017b
7. UNHCR, 2019c
8. United Nations, 2017.
9. ESCWA, 2019b; UNHCR, 2018.
10. Raydan and Salomon, 2016.
11. In Iraq, for instance, more than 360,000 people were living in precarious circumstances as of March 2019. UNHCR, 2019a.
12. For example: Gunning, R., 2014; Lahn et al., 2016; ESCWA, 2019b
13. United Nations, 2017.
14. United Nations, 2017.
15. United Nations, 2017.
16. United Nations, 2017.
17. United Nations, 2017.
18. United Nations, 2017.
19. United Nations, 2017.
20. United Nations, 2017.
21. United Nations, 2017.
22. United Nations, 2017.
23. United Nations, 2017.
24. United Nations, 2017.
25. United Nations, 2017.
26. United Nations, 2017.
27. United Nations, 2017.
28. United Nations, 2017.
29. United Nations, 2017.
30. United Nations, 2017.
31. International Energy Agency, 2019, p. 41.
32. International Energy Agency, 2019, p. 44.
33. For example: World Bank, 2008; Bassil, 2010; Naim, 2017; ESCWA, 2019b.
34. African Development Bank, 2016.
35. No data are available for Lebanon and Libya.
36. The World Health Organization differentiates between 95 percent confidence interval lower bound, point estimate, and 95 percent confidence interval upper bound access rates for CFTs, of which the point estimate is used for standard estimates.
37. World Bank, 2019d.
38. See footnote 45.
39. Lower-bound interval estimate at 95 percent confidence by the data provided by WHO.
40. World Bank, 2018a.
41. World Bank, 2018a.
42. Raydan and Salomon, 2016.
43. World Bank, 2018a.

Chapter 2

1. No data were available for 2017, making the tracking period for energy intensity 2014–2016 in this chapter.
2. World Bank, 2017d.
3. Energy Saving Association, 2014.
4. Dubai Electricity and Water Authority, 2018.
5. Planning and Statistics Authority, 2018.
6. International Energy Agency, 2014.
7. World Bank, 2019b.
8. ESCWA, 2019b.
9. International Monetary Fund, 2015.
10. Note that this ignores additional efficiencies in integrated power and water plants where power plant exhaust heat is used to desalinate water.
11. Arab Union of Electricity, 2016b.
12. Arab Union of Electricity, 2014 and 2016b.
13. United Nations, 2019a.
14. Global Fuel Economy Initiative, 2016.
15. Centre for Environment and Development for the Arab Region and Europe, 2015.
16. Centre for Environment and Development for the Arab Region and Europe, 2016.
17. Derived from World Bank, 2019e.
18. ESCWA, 2017c.
19. ESCWA, 2015b and 2015c and 2017b and 2018f; United Nations Development Programme, 2013c.
20. Estimated in ESCWA, 2018a.
21. ESCWA, 2019a, p.20.
22. International Energy Agency, 2015.
23. ESCWA (2019).
24. ESCWA, 2019a, p 84. discusses the associated benefits of this measure in detail.

Chapter 3

1. No data for renewable energy consumption are available for 2017.
2. El-Katiri, 2014. See also Energy Access Platform, 2019.
3. El-Katiri, 2014.
4. El-Katiri, 2014. For the example of this in the case of Yemen, see World Bank, 2005b.
5. ESCWA, 2015; 2017b.
6. Reviewer comments Samah Alsayed (IRENA), May 2019.
7. ESCWA, 2019b.
8. ESCWA, 2019b.
9. International Renewable Energy Agency, 2019b.
10. IRENA's Global Atlas tool provides detailed solar irradiation maps to illustrate this potential; International Renewable Energy Agency, 2019c.

11. ESCWA, 2019b.
12. ESCWA, 2019b.
13. ESCWA, 2019b.
14. ESCWA, 2019b.
15. Gebrayel, 2017, Slides 4 and 15.
16. Power Technology (undated).
17. International Renewable Energy Agency, 2019b.
18. International Renewable Energy Agency, 2019a.
19. E.g. Tizgui et al., 2018.
20. International Renewable Energy Agency, 2019a.
21. Camos et al., 2018.
22. Camos et al., 2018.
23. United Nations Development Programme, 2013a; 2018a; 2018b; 2018c.
24. International Renewable Energy Agency, 2019d.
25. ESCWA, 2019b.
26. International Renewable Energy Agency, 2019b.
27. ESCWA, 2019b; 2018c.
28. International Renewable Energy Agency, 2019b.
29. CAGR calculated based on International Renewable Energy Agency, 2019b.
30. International Renewable Energy Agency, 2019b.
31. ESCWA, 2018c.
32. ESCWA, 2019b.
33. ESCWA, 2019b.
34. ESCWA, 2019b; 2018c.
35. ESCWA, 2018c.
36. ESCWA, 2018c.
37. Taha, 2018.
38. ESCWA, 2019b.
39. Jabbour, 2017, Slide 2.
40. United Nations Development Programme / Decentralized Renewable Energy Power Generation, 2018.
41. World Bank, 2017a.
42. Depending on access to Zone C. World Bank, 2017a.
43. UNHCR, 2019b.
44. Jordan Response Platform for the Syria Crisis, 2019.
45. International Renewable Energy Agency, 2019b.
46. United Nations Development Programme, undated a.
47. United Nations Development Programme, undated b.
48. E.g. Yemen: Mahmoud et al., 2017; World Bank, 2018a.
49. World Bank, 2018b.
50. World Bank, 2019b.
51. World Bank, 2018b; African Development Bank, 2016; United Nations Development Programme, undated c
52. World Bank, 2019d.
53. International Renewable Energy Agency, 2015
54. United Nations Development Programme, undated c.
55. International Renewable Energy Agency, 2015
56. World Bank, 2019a.
57. World Bank, 2018b.
58. Review comment Adrian Whiteman, May 2019
59. ESCWA, 2019b.
60. International Renewable Energy Agency, 2019a, Middle East Solar Industry Association, 2018.
61. Habre, 2018.
62. Habre, 2018.
63. Arnold, 2019.
64. International Renewable Energy Agency, 2019a.
65. United Nations Development Programme / Decentralized Renewable Energy Power Generation, 2018, p.21.
66. World Bank, 2017a.
67. E.g. Huenteler et al., 2017.
68. All scores are available on the project's website; World Bank, 2017c.

Chapter 4

1. United Nations, 2019a.
2. ESCWA et al., 2017.
3. ESCWA et al., 2017.
4. United Nations Development Programme, 2013c.
5. Napoli et al., 2016.
6. El-Ashry et al., 2010. See also UNDP, 2013c.
7. ESCWA et al., 2017 p.47.
8. ESCWA, 2016a.
9. World Bank, 2012.
10. United Nations Development Programme, 2013c.
11. World Bank et al., 2004.
12. World Bank, 2018e.
13. Government of Abu Dhabi, undated.
14. https://www.moei.gov.ae/en/media-centre/news/7/1/2018/تعرف-على-برامج-عمل-استراتيجية-الأمن-المائي-2036-للإمارات.aspx#page=1.
15. ESCWA et al., 2017, p. 87.
16. ESCWA et al., 2017, p. 182
17. Nazrul I. et al. (2015)
18. ESCWA, 2015a ; ESCWA et al., 2017, p.92.
19. United Nations Framework Convention on Climate Change, 2017.
20. ESCWA, 2016a.
21. ESCWA, 2016a.
22. Caitlin et al., 2013, p. 24. See also ESCWA, 2016a.
23. Rehab Abd Almohsen, 2015. See also ESCWA, 2016a.
24. United Nations, 2007. See also ESCWA, 2016a.
25. E.g. Intergovernmental Panel on Climate Change, 2014.
26. World Resources Institute, 2016.
27. ESCWA, 2017d.
28. ESCWA et al., 2017, p 181-182.
29. ESCWA, 2016a, p. 5; see also UNDP et al., 2013.
30. The Guardian, 2015; World Bank World Bank and Energy Sector Management Assistance Programme, undated.
31. See also ESCWA, 2017e.
32. King Abdullah Petroleum Studies and Research Center, 2019, p. 14.
33. Strategy&, 2012.
34. International Energy Agency, 2018.
35. ESCWA, 2017f.
36. ESCWA, 2015b, p. 7
37. See also ESCWA, 2017g.
38. World Bank, 2019b.
39. ESCWA, 2019b.
40. World Health Organization, 2018
41. World Health Organization, 2018
42. World Health Organization, 2016.
43. ESCWA, 2015b, p. 7.
44. The Economist, 2016.
45. Middle East Economic Survey, 2017; International Energy Agency, 2012
46. ESCWA, 2016b. See also ESCWA, 2015c.
47. ESCWA, 2016b.
48. United Nations Development Programme, 2013c, p. 58.
49. United Nations Development Programme, 2013c, p. 59.
50. Lahn, G., P. Stevens F. and Preston, 2013
51. ESCWA, 2016b p.110.

52. ESCWA, 2016b, p.110.
53. International Renewable Energy Agency, 2019a, p. 115.
54. International Renewable Energy Agency, 2019a, p. 115.
55. Ecomena, 2017.
56. Eco-union & IEMed, 2017.
57. Eco-union & IEMed, 2017.
58. Eco-union & IEMed, 2017; African Development Bank Group, 2015.
59. Fattouh and El-Katiri, 2012b; International Monetary Fund, 2013; Sdralevich et al., 2014; International Monetary Fund, 2014; ESCWA, 2017h.
60. ESCWA, 2017a.
61. ESCWA, 2016b, p. 109
62. UNFCCC, 2015.
63. United Nations Framework Convention on Climate Change, 2015; All countries' INDCs are available online at the UNFCCC's INDC submissions portal at https://www4.unfccc.int/sites/submissions/indc/Submission%20Pages/submissions.aspx.
64. For example, see UNECE, 2015: Best Practices in Policies for Energy Efficiency, and IEA-RECREE, 2015: Regional Energy Efficiency Policy Recommendations; Arab-Southern and Eastern Mediterranean (SEMED) Region.
65. www.riccar.org/arab-climate-change-assessment-report-main-report; www.unescwa.org/publications/escwa-water-development-report-7; www.unescwa.org/publications/compendium-environment-statistics-arab-region-2016-2017; www.unescwa.org/publications/economic-development-integrated-water-resources-management ; www.unescwa.org/publications/human-settlements-integrated-water-resources-management; www.unescwa.org/publications/adaptation-climate-change-protect-human-health; www.unescwa.org/publications/climate-change-adaptation-agriculture-forestry-fisheries; www.unescwa.org/publications/ecosystem-management-integrated-water-resources-management; www.unescwa.org/publications/developing-capacities-integrated-water-resources-management; www.unescwa.org/publications/climate-projections-extreme-climate-indices-arab-region; www.unescwa.org/publications/guide-climate-change-negotiations-arab-countries.
66. https://unfccc.int/sites/default/files/english_paris_agreement.pdf
67. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/innovation-policy-inclusive-sustainable-development-arab-region-english_0.pdf
68. IRENA renewable energy jobs report https://www.irena.org/publications/2019/Jun/Renewable-Energy-and-Jobs-Annual-Review-2019; GCC report https://www.irena.org/publications/2019/Jan/Renewable-Energy-Market-Analysis-GCC-2019
69. http://eda.ac.ae/docs/default-source/Publications/eda-insight_gear-i_climate-change_en_web.pdf?sfvrsn=2

Chapter 5

1. http://www.aps.dz/economie/73089-le-taux-de-raccordement-national-au-reseau-d-electricite-a-depasse-les-90-a-la-fin-2017
2. International Renewable Energy Agency, 2016.
3. International Renewable Energy Agency, 2019b.
4. www.energy.gov.dz/francais/uploads/2016/Programme-National/Programme-National-Efficacite-Energetique.pdf
5. RECREEE Energy Efficiency AFEX 2017
6. International Renewable Energy Agency, 2019a.
7. SEU, 2018.
8. SEU, 2018.
9. http://www.seu.gov.bh/about-2
10. Verme, 2016.
11. Fattouh and El-Katiri, 2017.
12. ESCWA, 2019b.
13. International Renewable Energy Agency, 2018.
14. International Renewable Energy Agency, 2019b.
15. RECREE Energy Efficiency AFEX, 2017.
16. asa.gov.eg/Laws/mee/Laws/Law_87_2015.pdf
17. moee.gov.eg/test_new/DOC/p.pdf
18. Al-Khatteeb, L.H. and Istepanian, 2015.
19. International Energy Agency, 2019.
20. UNHCR, 2017b.
21. mop.gov.iq/static/uploads/8/pdf/
22. Iraq INDC, pp. 8–9
23. ESCWA, 2014.
24. Lahn, G., O Grafham and A.E.Sparr (2016)
25. ESCWA ,2019b.
26. http://www.memr.gov.jo/Pages/viewpage.aspx?pageID=264
27. SDG 7 tracking data pool
28. International Renewable Energy Agency, 2019b.
29. The Second National Energy Efficiency Action Plan (NEEAP) for the Hashemite Kingdom of Jordan, 2018–2020. Ministry of Energy and Mineral Resources
30. http://www.ozonactionmeetings.org/system/files/rasmi_hamzeh-_implementing_ee_programs_rac.pdf
31. KUNA, 15 March 2018
32. https://www.kuna.net.kw/ArticleDetails.aspx?id=2595433&language=en
33. https://www.mew.gov.kw/EnergyConserv.aspx
34. UNDP, 2017; Council for Development and Reconstruction, 2016; World Bank, 2009.
35. UNHCR, 2017a.
36. International Renewable Energy Agency, 2018b.
37. CEDRO-UNDP, 2014.
38. ESCWA, 2018d.
39. Tsagas,I., 2018.
40. The Second National Energy Efficiency Action Plan for the Republic of Lebanon, NEEAP 2016-2020, March 2016, Lebanese Centre for Energy Conservation (LCEC)
41. Climate Finance Loan schemes, existing and planned loans schemes in Lebanon, Climate Change, September 2014 http://climatechange.moe.gov.lb/viewfile.aspx?id=216
42. Lebanon Energy Efficiency and Renewable Energy Finance Facility, LEEREFF, September 2018 https://beirutenergyforum.com/p18/LEEREFF%20Products%20and%20Processes.pdf
43. UNHCR, 2017b.
44. African Development Bank, 2016.
45. African Development Bank, 2016.
46. International Renewable Energy Agency, 2015, p. 17
47. Masdar, undated.
48. International Renewable Energy Agency, 2016, p. 11
49. ESCWA, 2017.
50. Information about the Noor Ouarzazate complex is available from MASEN's website at http://www.masen.ma/fr/publications/rapports/noor-ouarzazate.
51. E.g. Temasol, undated.
52. International Renewable Energy Agency, 2019b.
53. www.invest.gov.ma/?Id=24&lang=ar&RefCat=2&Ref=145

54. www.mcinet.gov.ma/ar/content/
55. RECREE Energy Efficiency AFEX, 2017.
56. International Renewable Energy Agency, 2019.
57. International Renewable Energy Agency, 2019.
58. RECREE AFEX Energy Efficiency, 2017.
59. UNDP, Undated b.
60. ESCWA, 2019b.
61. Details of domestic electricity tariffs across Arab countries are available from Arab Union of Electricity, 2016.
62. ESCWA, 2019b.
63. ESCWA, 2019c. NREAP of Palestine 2030, 2018.
64. World Bank and ESMAP, 2017. Securing Energy for Development in West Bank and Gaza
65. www.perc.ps/ar/files/enrgy/General%20strategy.pdf
66. International Renewable Energy Agency, 2019.
67. Kahramaa Sustainability Report 2016 www.km.qa/MediaCenter/Pages/Publications.aspx
68. International Renewable Energy Agency, 2019.
69. International Renewable Energy Agency, 2019.
70. Gulf Business, 2019.
71. Country Energy Efficiency Report https://library.e.abb.com/public/3286e88f2467b11dc1257be80055df20/Saudi%20Arabia.pdf
72. Gobat, J. and K. Kostial, 2016.
73. UNDP, 2016.
74. ESCWA, 2019b.
75. Naim, 2017.
76. ESCWA, 2019b.
77. ESCWA, 2019b.
78. ESCWA, 2019b.
79. ESCWA, 2019b.
80. ESCWA, 2019b.
81. ESCWA, 2019b.
82. IEA, IRENA, UNSD, WB, and WHO, 2019.
83. International Monetary Fund, 2017b.
84. mininfo.gov.sd/
85. International Renewable Energy Agency, 2019b. IRENA data for wind and solar capacity in power generation increased at an average annual rate of 2 percent and 42 percent respectively between 2014-2017.
86. UNDP, 2018a.
87. International Renewable Energy Agency, 2019b.
88. Loi N° 2013-54, Art. 67, Journal Officiel de la République Tunisienne, 30 December 2013 http://www.legislation.tn/sites/default/files/fraction-journal-officiel/2013/2013F/105/Tf2013541.pdf
89. www.legislation.tn/detailtexte/D%C3%A9cret%20Gouvernemental-num-2017-983-du-26-07-2017-jort-2017-071__20170710098332
90. IMF, 2017a.
91. International Renewable Energy Agency, 2019a.
92. International Renewable Energy Agency, 2019a.
93. Government of the United Arab Emirates, 2018.
94. www.dewa.gov.ae/ar-AE/about-dewa/news-and-media/press-and-news/latest-news/2017/03/dubai-supreme-council-of-energy-approves-dubai-green-fund-road-map-at-44th-meeting
95. http://taqati.ae/dies-2030/
96. World Bank (2018)
97. World Bank (2018)
98. Mahmoud, M. et al. (2017). See also World Bank (2018).
99. RECREE AFEX Energy Efficiency 2017

About the data used in this report

1. Comoros, Djibouti and Somalia are not included in this ESCWA Report as they are covered by the regional report developed by the regional Economic Commission for Africa.
2. In this Report, "State of Palestine" is used for the data that cover "west Bank and Gaza". We also use "Palestine" and "Occupied Palestinian territory" to specify Palestine
3. World Bank, 2019d, pp. 34–36
4. World Bank, 2019d, pp. 34–36.
5. World Bank, 2019d, pp. 34–36.
6. ESCWA, 2019b.
7. World Bank, 2019d, pp. 34–36.
8. World Bank, 2019d, pp. 57–58.
9. World Bank, 2019d, pp. 57–58.
10. World Bank, 2019d, pp 96–97
11. World Bank, 2019d, pp 96–97
12. World Bank, 2019d, pp 96–97
13. World Bank, 2019d, pp 96–97
14. World Bank, 2019d, pp. 96–97
15. World Bank, 2019d, pp. 96–97
16. World Bank, 2019d, pp. 96–97
17. World Bank, 2019d, pp. 96–97
18. World Bank, 2019d, pp. 96–97
19. For a detailed explanation of this method of calculation, see IEA, IRENA, UNSD, World Bank and WHO (2019).

This publication is the latest and most thoroughly updated regional edition of the Sustainable Development Goal 7 (SDG 7) Regional Tracking Report which addresses access to sustainable and modern energy for all. Developed by ESCWA, it aims to help build capacity in the Arab region, through access to information, with the aim of strengthening proactive policy to improve energy security, enhance resilience in the face of climate change and mainstream sustainable development goals into regional and national policy processes.

This report tracks progress in SDG 7 at Arab regional and country levels through the three main indicators of energy access, energy efficiency and renewable energy. It also traces the interlinkages between progress in SDG 7 and SDG 13 on climate action.

Achieving SDG 7 in the Arab region constitute one of the most fundamental challenges across all Arab countries in the coming decades: it requires a significantly scale-up of progress in renewable energy and in decoupling regional growth from energy consumption. This must be done through improved energy efficiency and increasing productivity of energy use while, at the same time, protecting the climate and ensuring a healthy planet for future generations.

19-00976